Report No. NAWCADWAR-93016-60

EFFECT OF FIBER-MATRIX INTERPHASE ON TRANSVERSE TENSILE STRENGTH AND FRACTURE RESISTANCE OF ORGANIC COMPOSITE MATERIALS

H.C. Tsai and A. Arocho
Air Vehicle and Crew Systems Technology Department (Code 6043)
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION WARMINSTER
P.O. Box 5152
Warminster, PA 18974-0591

4 September 1993

FINAL REPORT

Approved for Public Release; Distribution Is Unlimited

Prepared for
Air Vehicle and Crew Systems Technology Department (Code 60)
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION WARMINSTER
P.O. Box 5152
Warminster, PA 18974-0591

PUBLIC RELEASE
NADC 5720/3 (REV 11-89)

FROM: Hsi Tsai - 6043

DATE: 3-7-94

TO:
PUBLIC AFFAIRS OFFICER

VIA: (1) Division Manager
(2) Director

Ref: (a) NAVAIRDEVCENINST 5720.4

ENCL: (1) One copy of material for which release is requested

MATERIAL ENTITLED Effect on Fiber-Matrix Interphase On Transverse Tensile Strength And Fracture Resistance Of Organic Composite Materials

THIS MATERIAL IS INTENDED FOR PUBLICATION IN: *(Name of publication, if applicable)*	DATE OF PUBLICATION	DEADLINE
NAWCADWAR-93016-60	9-2-93	

THIS MATERIAL IS INTENDED FOR PRESENTATION AT: *(If applicable)*

LOCATION OF MEETING	DATE OF MEETING	DEADLINE FOR SUBMISSION

1. In accordance with the provisions of reference (a), it is requested that the subject material be approved for unclassified publication or presentation.
2. It is my opinion, that the subject matter in this paper is not classified and has no military application requiring classification.
3. To the best of my knowledge, this material does not disclose any trade secrets or suggestions of outside individuals or concerns which have been communicated to the center with confidence.
4. Any inventions disclosed in this material have been considered for patent protection by the government, and any copyrighted material is being used with the written consent of the owner.
5. This material may be released AS IS ☐ AS AMMENDED ☐

SIGNATURE *(Orginator)* (6043 - Hsi Tsai) [signature]

APPROVALS

1. I have reviewed this material for desirability of open publication and for aptness of security classification.
Release recommended YES ☑ NO ☐

SIGNATURE *(Division Manager)* (604) Ralph M. Catanese DATE 29 June 94

2. I have reviewed this material for desirability for open publication and for aptness of security classification. Permission to submit this paper or abstract for consideration and subsequently for presentation in the Continental United States is:
APPROVED (CONUS) ☑ DISAPPROVED ☐ REFERRED TO NAVAIRDEVCEN TECHNICAL DIRECTOR ☐ (OUTSIDE CONUS)

SIGNATURE *(Director)* (604) T. Millour DATE 6/29/94

3. For presentation outside the Continental U.S. only. Premission to submit this paper for consideration and subsequently for presentation outside the Continental U.S. is:
APPROVED ☐ DISAPPROVED ☐

SIGNATURE *(Technical Director)* (N/A) DATE

4. I have reviewed this material for desirability for open publication and for aptness of security classification.
Release recommended YES ☑ NO ☐

SIGNATURE *(Security Officer)* (044) [signature] DATE 13 Jul 94

5. I have reviewed this material for compliance with reference (a), and completion of all required reviews.
Request for Public Release: APPROVED ☑ DISAPPROVED ☐ FORWARDED FOR HIGHER LEVEL REVIEW ☐

SIGNATURE *(Public Affairs Officer)* (041) [signature] DATE 15 Jul 94

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1993	Final Report 10/91 - 9/93

4. TITLE AND SUBTITLE
EFFECT OF FIBER-MATRIX INTERPHASE ON TRANSVERSE TENSILE STRENGTH AND FRACTURE RESISTANCE OF ORGANIC COMPOSITE MATERIALS

5. FUNDING NUMBERS

6. AUTHOR(S)
Hsi chin Tsai
Annette Arocho

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Vehicle and Crew Systems Technology Department (Code 6043)
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION WARMINSTER
P.O. Box 5152
Warminster, PA 18974-0591

8. PERFORMING ORGANIZATION REPORT NUMBER
NAWCADWAR-93016-60

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Air Vehicle and Crew Systems Technology Department (Code 6013)
NAVAL AIR WARFARE CENTER
AIRCRAFT DIVISION WARMINSTER
P.O. Box 5152
Warminster, PA 18974-0591

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Unidirectional fiber reinforced composites have a very low transverse tensile strength. This strength is much lower than the strength of the pure matrix and limits the performance of the composite system.

The objective of this IR program is to develop analytical methods which predict the transverse tensile failures of organic composites and to examine how various parameters influence the transverse tensile strength and failure modes.

Analytical methods developed in this study included micromechanical models for the composite without initial microcracks and micromechanical models for the composite with initial microcracks. Through these models, local stress distribution, stress intensity factor, and thermal residual stresses were calculated. Guidelines and design charts for the improvement of the transverse tensile strength were also developed.

14. SUBJECT TERMS – Key Words
Micro Mechanics, Fiber-Matrix Interphase, Transverse Tensile Strength, Thermal Residual Stresses, Fracture Toughness

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF FIGURES

Figure Page

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Unidirectional fiber reinforced composites have a very low transverse tensile strength. This strength, in general, is much lower than the strength of the pure matrix and limits the performance of the composite system. The transverse tensile strength of a composite is dependent upon the fiber-matrix interfacial bonding strength, matrix strength, transverse fiber strength and stiffness ratio between fiber and matrix, etc. Material defects such as voids in the matrix, broken fibers, microcracks and fiber-matrix disbonds will degrade the transverse tensile strength of composite materials. Conventional analysis methods (refs. 1-3), which treat the fiber and matrix as two phase, homogeneous and isotropic materials, provide ways to predict the transverse tensile strength of the composite, but the correlation between these analytical results and test results is not satisfactory.

Recently, several researchers (refs. 4, 5) have suggested that the volume of matrix material immediately surrounding the fiber is significantly different from the bulk matrix. This volume of material is commonly referred to as the interphase. It is believed that the interphase, though small in thickness, has significant effect on the strength and fracture toughness of the composite. To verify this concept, these authors (ref. 6) have developed micromechanical models which treat the fiber reinforced composite as a three-phase material, namely, fiber, interphase and bulk matrix. Through the analysis of the microdebonding problem, it has been shown that the model including an interphase between fiber and matrix provides a much better prediction of debonding loads than the model without the interphase.

The purpose of this study is to determine the effect of the fiber-matrix interphase on the transverse tensile strength of the composite. Since the transverse tensile strength is very low, there is a potential for engineering material improvements based

upon a better understanding of the transverse failure mechanics, so that higher composite transverse tensile strength can be obtained.

This report is divided into four parts. Part 1 describes the effect of interphase on the transverse tensile strength of the composite without defects. Part 2 describes the effect of thermal residual stresses on the transverse tensile strength of the composite. Part 3 describes the transverse tensile strength of the composite with initial flaw. Part 4 provides guidelines and design charts of interphase properties and thickness for improving the transverse tensile strength of a unidirectional composite.

2.0 EFFECT OF FIBER MATRIX INTERPHASE ON THE TRANSVERSE TENSILE STRENGTH OF ORGANIC COMPOSITE MATERIALS WITHOUT INITIAL DEFECTS AND WITHOUT INCLUDING THE THERMAL RESIDUAL STRESSES

2.1 METHOD OF ANALYSIS

The composite material is assumed to consist of a square array of unidirectionally elastic circular filaments in an infinite elastic matrix as shown in figure 1. This simple packing geometry has been known to give satisfactory results (ref. 7). The filaments are assumed to be perfectly bonded to the matrix. By assuming a square packing arrangement, a repeating unit can be isolated, as indicated by the solid lines a-a-a-a shown in figure 1. For a composite subjected to a remotely applied average tensile stress in the x direction, σ_T , the conditions of symmetry require that boundary lines of this repeating unit in the deformed composite remain parallel to the corresponding lines of the undeformed material, i.e., as shown in figure 1, line a' - a' is parallel to the corresponding boundary line a - a. This implies that the gross strains over the length 2L in directions x and z remain constant.

$$\frac{1}{2L}\int_{-L}^{L}\varepsilon_X\,dx = \varepsilon_T = \text{constant (at any z)} \tag{1}$$

$$\frac{1}{2L}\int_{-L}^{L}\varepsilon_z\,dz = \varepsilon_Z = \text{constant (at any x)} \tag{2}$$

Also, at any section across the element 2L the conditions of force equilibrium require that

$$\sigma_T = \frac{1}{2L}\int_{-L}^{L}\sigma_X\,dz \tag{3}$$

$$0 = \frac{1}{2L}\int_{-L}^{L}\sigma_z\,dx \tag{4}$$

Having established the assumptions of square packing, gross strain and stress conditions, the physical problem can be formulated as follows

2.1.1 ONE-DIMENSIONAL PREDICTION METHODOLOGY

The repeating unit to be modeled which includes the interphase is shown in figure 2. The basic concept for the one-dimensional model is shown in figure 3. The material response to the external transverse tensile stress, σ_T, can be approximated by the response of a one-dimensional series spring system.

In the region consisting of fiber, interphase and matrix, there will be three distinct stiffnesses corresponding to each constituent. In the region consisting of interphase and matrix, there will be two distinct stiffnesses corresponding to interphase and matrix. At the region, $Z \geq R + t_i$, there will be only one stiffness, namely, stiffness of matrix. From the basic concept, we can conclude that

$$\begin{aligned} &\sigma_f = \sigma_i = \sigma_m = \sigma_L \qquad && 0 \leq Z \leq R \\ &\sigma_m = \sigma_i = \sigma_L && R \leq Z \leq R + t_i \end{aligned} \tag{5}$$

where σ_f, σ_i, σ_m = stress in the fiber, interphase and matrix respectively

σ_L = local stress

Based on this concept, the local stress at three regions can be derived as follows:

(1) $0 \leq Z \leq R$

This region includes three phases, namely, fiber, matrix and interphase. The total displacement, as shown in figures 2 and 3, at $x = L$, can be written as

$$U = \varepsilon_f \cdot \overline{AB} + \varepsilon_i \cdot \overline{BC} + \varepsilon_m \cdot \overline{CD} \tag{6}$$

where

ε_f = strain in the fiber

ε_i = strain in the interphase

ε_m = strain in the matrix

Divide both sides of equation (6) by L. We have

$$\varepsilon_T = \varepsilon_f k_f + \varepsilon_i k_i + \varepsilon_m (1 - k_f - k_i) \tag{7}$$

From the assumption of square packing array, it can be proved that

$$\begin{aligned} k_f &= \left(\frac{4V_f}{\pi}\right)^{\frac{1}{2}} \left\{1 - \left(\frac{Z}{R}\right)^2\right\}^{1/2} \\ k_i &= \left(\frac{4V_f}{\pi}\right)^{1/2} \left\{\left[\left(1 + \frac{t_i}{R}\right)^2 - \left(\frac{Z}{R}\right)^2\right]^{1/2} - \left[1 - \left(\frac{Z}{R}\right)^2\right]^{1/2}\right\} \\ k_m &= 1 - k_f - k_i \\ V_f &= \text{volume fraction of the fiber} \end{aligned} \tag{8}$$

From the stress-strain relationship, we have

$$\begin{aligned} \varepsilon_f &= \frac{\sigma_f}{E_f} \\ \varepsilon_i &= \frac{\sigma_i}{E_i} \\ \varepsilon_m &= \frac{\sigma_m}{E_m} \end{aligned} \tag{9}$$

Substituting equation (9) into (7) and making use of equation (5), the local stress, σ_L, in this region can be expressed as follows

$$\sigma_L = \varepsilon_T \qquad \frac{1}{\frac{k_f}{E_f} + \frac{k_i}{E_i} + \frac{(1 - k_f - k_i)}{E_m}} \tag{10}$$

(2) $R \leq Z \leq R + t_i$

This region includes matrix and interphase. The total displacement, as shown in figure 2, contributed from these constituents can be written as follows

$$U = \varepsilon_i \cdot \overline{EF} + \varepsilon_m \cdot \overline{FG} \tag{11}$$

Divide both sides of equation (11) by L, we have

$$\varepsilon_T = \varepsilon_i k_i + \varepsilon_m (1 - k_i) \tag{12}$$

where

$$k_i = \left(\frac{4V_f}{\pi} \right)^{\frac{1}{2}} \left\{ \left(1 + \tfrac{t_i}{R}\right)^2 - \left(\tfrac{Z}{R}\right)^2 \right\}^{\frac{1}{2}} \tag{13}$$

By this same token, the local stress, σ_L, in this region can be written as follows

$$\sigma_L = \varepsilon_T \quad \frac{1}{\left\{ \frac{k_i}{E_i} + \frac{(1-k_i)}{E_m} \right\}} \tag{14}$$

(3) $R + t_i \leq Z \leq 1$

This region consists of matrix material only. By the same token, the local stress, σ_L, in the region can be expressed as

$$\sigma_L = \varepsilon_T \ \frac{1}{\left(\frac{1}{E_m} \right)} \tag{15}$$

If ε_T is known, then the local stress, σ_L, can be obtained from equations (10), (14) and (15) for the corresponding region.

In the case where only the applied transverse tensile stress, σ_T, is known, then equation (3) will be used to obtain the local stress.

Employing equation (3), the local stress, σ_T, can be expressed as follows

$$\sigma_L = \sigma_T \left(\frac{E_m}{E_T}\right) \frac{1}{[1-k_f(1-E_m/E_f)-k_i(1-E_m/E_i)]} \qquad 0 \le Z \le R \tag{16}$$

$$\sigma_L = \sigma_T \left(\frac{E_m}{E_T}\right) \frac{1}{[1-k_i(1-E_m/E_i)]} \qquad R \le Z \le R+t_i \tag{17}$$

$$\sigma_L = \sigma_T \left(\frac{E_m}{E_T}\right) \qquad R+t_i \le Z \le L \tag{18}$$

where

$$\frac{E_T}{E_m} = \frac{1}{L}\left\{\int_0^R \frac{dz}{[1-k_i(1-E_m/E_i)-k_f(1-E_m/E_f)]} + \int_R^{R+t_i} \frac{dz}{[1-(1-E_m/E_i)k_i]} + L-(R+t_i)\right\} \tag{19}$$

Equation (19) can be solved through numerical integration

Define

$$\text{S.C.F.} = \text{stress concentration factor } = \frac{\sigma_L}{\sigma_T} \tag{20}$$

Making use of equations (16) through (20), we can obtain S.C.F. at any location in the composite material.

2.1.2 TWO DIMENSIONAL MODEL

The basic concept, which was originated from reference 2, will be adopted in this paper as shown in figure 4. The solution procedure can be divided into two parts. One

is to solve the two-dimensional plane strain problem with $U = \Delta U$ at $x = \pm L$, and $V = 0$, at $Z = \pm L$, the other is to solve the two-dimensional plane strain problem with $V = \Delta V$ at $Z = \pm L$, $U = 0.0$ at $x = \pm L$. The final solution will be the linear combination of these two solutions so that equations (3) and (4) will be met. The detailed derivation is in Appendix A.

Only one quadrant of the circular fiber cross section and the surrounding inter-phase and matrix material needs be analyzed due to symmetry. The finite element model used in this study is shown in figure 5. The mesh refinement at the fiber-matrix interfacial region is evident. The 'ABAQUS' computer code was used to solve this two-dimensional plane strain problem.

2.2 VALIDATION OF ANALYTICAL METHODS

In this analysis, it is assumed that an individual point failure immediately causes failure of the whole material. We recognize that, depending upon the failure locations and the properties of the constituents, this assumption may not be true. Yet the presence of an individual point failure suggests failure of the whole material and provides a conservative prediction. Maximum normal stress failure criterion will be used to determine the failure of the individual point in the material. According to this criterion, fracture is assumed to have occurred if any one of the three principal stresses at this individual point reach the ultimate strength of the corresponding constituent.

2.2.1 VALIDATION OF ONE-DIMENSIONAL MODEL

The comparison between the theoretical and experimental transverse stress distribution is shown in figure 6. The test-theory correlation for the maximum stress concentration is shown in figure 7.

The test data (ref. 1) were obtained from transverse tensile loading tests on plates containing aluminum inclusions imbedded in epoxy resin. As shown in figure 6, one-dimensional theory provides accurate predictions as compared with test data.

Figure 7 shows the maximum transverse tensile stress, which occurs at $Z = 0.0$ as a function of the volume fraction of the fiber. Again, it can be seen that one dimensional theory provides very good correlations.

Another example to verify the accuracy of the one-dimensional theory is shown in figure 8. The test data were obtained from reference 9. The correlation between analytical results and test results is reasonably good. Since most test data is above the curve with $E_m/E_i = 1.0$, this may suggest that the composite possesses the interphase and the interphase is a soft interphase.

2.2.2 VALIDATION OF TWO-DIMENSIONAL MODEL

The same composite as shown in figures 6 and 7 is modeled. The comparison between the theoretical and experimental transverse stress distribution is shown in figures 9 and 10. The test-theory correlations for the maximum transverse stress is shown in figure 11. Again, as shown in figures 9 and 10, both two dimensional models predict good results as compared with the test data. Figure 11 shows that one dimensional model suprisedly predicts better results than that of two dimensional models.

2.2.3 COMPARISON OF ONE-DIMENSIONAL AND TWO-DIMENSIONAL RESULTS

Table I shows the stress concentration factor of the composite, with $E_f/E_m = 21.3$, $V_f = 0.65$, $t_i/R = .015$. The agreement between one-dimensional model and two-dimensional model is excellent.

From the above comparisons, we conclude that the one-dimensional model is accurate enough to be used to predict the local stress of the composite under transverse loading. Also, the one-dimensional model can be used as a first approximation to estimate the interphase modulus and thickness. By using an iteration scheme and two-dimensional analysis, accurate interphase modulus and thickness estimates of the composite can be obtained.

2.3 APPLICATIONS

The one-dimensional model has been verified in the previous section as an adequate model to predict the local stress of the composite. Unless otherwise noted, the following analyses are based on one-dimensional theory.

Effect of Interphase Moduli and Thickness on Stress Concentration Factors of the Composite

Equation (16) was used to calculate the stress concentration factor at $Z=0$, for various E_m/E_i and t_i/R. Figures 12 and 13 show the results. Certain conclusions can be drawn: (1) with fixed t_i/R the softer the interphase, the lower the stress concentration factor, (2) with softer interphase and E_m/E_i fixed, the larger the interphase thickness the lower the stress concentration factor. For stiffer interphase (i.e., $E_m/E_i \leq 1.0$), the smaller the interphase thickness, the less the stress concentration factor.

2.3.1 *Effect of E_f/E_m and E_m/E_i on the Maximum Stress Concentration Factor of the Composite*

From figure 14, one can see that the higher the E_f/E_m, the larger the stress concentration for all kinds of interphases. But, the degree of influence is decreased as the interphase becomes softer.

2.3.2 *The Shift of the Critical Location and the Optimal Interphase (or Coating)*

Equations (16), (18) and (19) were used to calculate the stress concentration factors at $Z = 0.0$ and $R + t_i \leq Z \leq L$, the results are shown in figure 15. $\theta = 0^\circ$ represents the line $Z = 0$, while $\theta = 90^\circ$ represents line $X = 0.0$ and $R + t_i \leq Z \leq L$. As one can see from this figure, curve $(\text{S.C.F.})_{\theta=0^\circ}$ and $(\text{S.C.F.})_{\theta=90^\circ}$ intersect at $E_m/E_i = (E_m/E_i)_c$ and

$$(\text{S.C.F.})_{\theta=0^\circ} \geq (\text{S.C.F.})_{\theta=90^\circ}, \text{ for } \mathrm{E_m/E_i} \leq (E_m/E_i)_c$$
$$(\text{S.C.F.})_{\theta=0^\circ} \leq (\text{S.C.F.})_{\theta=90^\circ}, \text{ for } \mathrm{E_m/E_i} \geq (E_m/E_i)_c$$

Also, the two-dimensional analysis shows that for $E_m/E_i \geq (E_m/E_i)_c \sigma_L^{max}$ occurs at "b" as shown in figure 16, from equations (16) and (18), $(E_m/E_i)_c$ can be expressed as follows

$$(E_m/E_i)_c = 1.0 + [1 - (E_m/E_f)]/(t_i/R) \tag{21}$$

Two-dimensional analysis had been performed and confirmed the transition of the critical location. From equation (21), one can conclude that (1) failure will occur at $\theta = 0^\circ$, if $E_m/E_i \leq E_{ic}$, (2) for $E_m/E_i \geq (E_m/E_i)_c$ failure will occur at $\theta = 90^\circ$ and $Z = R + t_i$, (3) for $E_m/E_i = (E_m/E_i)_c$, failure will occur at $\theta = 0^\circ$ and 90° simultaneously. Figure 16 shows the critical stress concentration factors at these three regions. It is evident that $E_m/E_i = (E_m/E_i)_c$ is the optimal interphase modulus to ensure the least stress concentration factor. Figure 17 shows curves of critical stress concentration factor for various interphase thicknesses. Curve a b c d constitutes the optimal interphase for the composite with fiber volume fraction equal to .65 and $E_f/E_m = 25.0$. For varying fiber volume fraction, the curves for optimal interphase are shown in figure 18. These curves can be used to design the interphase or coating to obtain the maximum transverse tensile strength of the composite. Figure 19 shows how the interphase affects the transverse tensile strength as compared with the

transverse tensile strength of the composite without interphase for various fiber volume fractions. It can be seen that the transverse tensile strength, for the composite with $E_f/E_m = 21.3$ and $t_i/R = .0286$, can be increased as much as 43%, 38% and 34% for $V_f = .65$, .57 and .502 respectively. Notice that the above results are based on the assumption that the strength in matrix, interphase and interface is the same.

2.3.3 *Effect of Interphase Properties on the Transverse Failure Modes of the Composite*

One-dimensional models can not detect the location of failure because the local transverse tensile stress is assumed to be the same in the fiber, interphase and matrix at constant Z and any X as expressed in equation (5). For this purpose, the two-dimensional model must be used. Figure 20 shows the stress distribution in the interphase and matrix at $Z = 0$ as a function of interphase modulus. As shown in this figure, the assumption that the stress at the matrix and interphase is equal for one-dimensional theory is approximately correct. Also, for $1.0 \leq E_m/E_i \leq 5.0$, the local transverse tensile stress in the matrix is higher than in the interphase. Thus, in this range, matrix cracking is the failure mode. For $5.0 \leq E_m/E_i$, the stress in the interphase or interface is higher than the stress in the matrix. Thus, in this range, failure will occur either in the interphase or at the interface. Based on this idea, one can obtain the critical stress concentration factor and failure mode of the composite as a function of interphase modulus and thickness as shown in figures 21 and 22.

Notice that the above results are based on the assumption that the strength in matrix, interphase and interface is the same. If the tensile strength of the matrix and interphase (or coating), and the disbonding strength of the interface are known, then similar design curves as shown in figures 21 and 22 can also be produced to determine the transverse tensile strength and the failure mode as the function of interphase modulus and thickness.

2.4 CONCLUSIONS

Interphase thickness and modulus have significant influence on the transverse tensile strength of unidirectional fiber reinforced composites. A soft interphase is shown to reduce the stress concentration factor, hence increasing the transverse tensile strength of the composite. In order to increase transverse tensile strength of a composite, the interphase modulus should be decreased and/or the thickness of the interphase should be increased. The location for maximum stress concentration factor varies with interphase modulus and thickness, hence the mode and location of failures may be changed by changing these parameters.

3.0 EFFECT OF THERMAL RESIDUAL STRESSES ON THE TRANSVERSE TENSILE STRENGTH OF ORGANIC COMPOSITE MATERIALS

In this section, the effect of thermal residual stresses on the transverse tensile strength of organic composite materials is studied. The analytical method developed in this study can be applied to any other composite system as long as thermal loading is in elastic range.

3.1 MICROMECHANICAL MODEL FOR THERMAL RESIDUAL STRESS ANALYSIS

Two dimensional finite element model, as shown in figure 5, was used to determine the thermal residual stresses with the plane strain condition being assumed. As shown in figure 23 the solution procedure can be divided into three parts. First is to solve the two dimensional plane strain problem with $U = \Delta U$ at $X = \pm L$, and $W = 0.0$ at $z = \pm L_i$, second is to solve the two dimensional plane strain problem with $W = \Delta W$ at $z = \pm L$, and $U = 0.0$ at $z = \pm L$, and the third is to solve the thermal stress problem with fixed boundary condition and uniform ΔT imposed on fiber, matrix and interphase. The final solution will be linear combination of these three solutions so that the force boundary conditions are met. The detailed solution procedure is described in Appendix B. Again, the "ABAQUS" Computer Code was used to solve this thermal residual stress problem.

3.2 VALIDATION OF THERMAL RESIDUAL STRESS ANALYSIS

Thermal residual stress solutions obtained through finite element analysis have been compared with finite difference solution (ref. 2) for three fiber volume fractions, $V_F = .5$, .57 and .65, as shown in figure 24. The correlation between these two methods is in good agreement.

3.3 RESULTS OF THERMAL STRESS ANALYSIS

3.3.1 THERMAL STRESS DISTRIBUTION AROUND THE CIRCUMFERENTIAL DIRECTION

Figure 25 shows the thermal residual stress distribution around the circumferential direction. As can be seen in the figure, the axial stress and tangential stress are always tensile, while the radial stress in most part is under compression. The shear residual stress exists but is not as significant as normal stresses. Since the radial residual stress at $\theta = 0^{\circ}$ is under compression with maximum value, it seems that thermal residual stress may increase the transverse tensile strength of the composite, but this is not so as will be seen in later discussions. Also, since the magnitudes of axial and tangential residual stresses on large, these stresses may cause initial crack even before any loading is applied.

3.3.2 EFFECT OF INTERPHASE PROPERTIES ON THERMAL RESIDUAL STRESSES OF THE COMPOSITE

Figure 26 shows the transverse residual stresses at $\theta = 0^{\circ}$ (i.e., at location 'a') and $\theta = 90^{\circ}$ (i.e., at location 'b') as function of interphase properties, including the effect of thermal expansion coefficients. It can be seen that the softer the interphase elastic property, the higher the tensile transverse residual stress at 'b' and the lower the compressive transverse residual stress at 'a'. Also as can be seen from this figure, both transverse thermal residual stresses at 'a' and 'b' do not vary much as $E_m/E_i > 10.0$.

If thermal expansion coefficient of interphase is less than the thermal expansion coefficient of matrix, there is not much difference in thermal residual stresses between these two cases. on the other hand, if the thermal expansion coefficient of interphase is greater than that of matrix, the thermal residual stresses are vastly reduced. This suggests that if the reduction of the thermal residual stresses is desired, an interphase with high thermal expansion coefficient should be selected.

3.4 DETERMINATION OF THE TRANSVERSE TENSILE STRENGTH AND FAILURE LOCATION OF THE COMPOSITE INCLUDING THE EFFECT OF THE THERMAL RESIDUAL STRESSES.

The failure of the composite under transverse loading is directly related to interphase properties, matrix strength, fiber-matrix interface strength and interphase strength, and relative stiffness ratio between fiber and matrix. Hence, the failure can occur at the matrix, or fiber-matrix interface, or interphase.

Let σ_{mu} be the matrix tensile strength, σ_{iu} be either interphase strength or interface bonding strength, σ_m^o and σ_i^O be the thermal residual stresses at matrix and interface (or interphase) respectively, based on point failure criterion, following failure equations are obtained.

If the failure occurs at matrix, the failure equation can be expressed as follows:

$$\sigma_{mu} = K_m \sigma_T + \sigma_m^\circ \qquad (22)$$

Rearrange equation (22), we have

$$\sigma_T^m = \left(\sigma_{m\mu} - \sigma_m^0\right)/k_m \qquad (23)$$

where

$\sigma_T^m =$ transverse tensile stress of the composite which causes failure at matrix

$k_m =$ stress concentration factor at matrix

Equation 23 will be used to determine the external transverse loading which causes failure at matrix.

We next consider the case that the failure occurs at interface or interphase region, the failure equation can be expressed as the following

$$\sigma_T^i = \left(\sigma_{iu} - \sigma_i^0\right)/K_i \tag{24}$$

where

$k_i =$ stress concentration factor at interface or interphase

$\sigma_T^I =$ transverse tensile stress of the composite which causes failure at interface or interphase

Equation 24 will be used to determine the external transverse loading which causes failure either at fiber-matrix interface or interphase.

The transverse tensile strength of the composite will be determined as the least of σ_T^m and σ_T^I at all critical locations.

From figure 25, since hoop thermal residual stress is always tensile, from equation (23) and (24), it is very likely that the failure may occur at location other than $\theta = 0^\circ$. If this is the case, then the higher the thermal residual stress, the lower the transverse tensile strength. As shown in the next section, these situations occur for composites with low interfacial and matrix strength.

3.4.1 FAILURE LOCATIONS FOR COMPOSITES SUBJECTED TO TRANSVERSE TENSILE LOAD

If we assume that the fiber-matrix interface bonding strength is equal to the matrix strength, figure 27(a) and (b) show the possible failure locations for a composite subjected to transverse tensile load. If thermal residual stresses do not exist in a composite, figure 27(a) shows that the failure locations will be either at $\theta = 0^\circ$ and

$r \geq r_f$, as long as $(E_m/E_i) \leq (E_m/E_i)_{cr}$ or at $\theta = 90^{\circ}$ and $r = r_f + t_i$ for $(E_m/E_i) > (E_m/E_i)_{cr}$

However, if thermal residual stresses do exist in a composite, then failure will occur at places other than those shown in figure 27(a).

Figure 27(b) shows the potential failure locations for a composite with thermal residual stresses. Figure 28 shows the effect of matrix strength and interfacial strength on the transverse tensile strength and failure locations of composites. As we can see in the figure, for this special composite, when σ_{mu} less than 13 KS_i, the failure occurs at point "1" to point "4" depending upon the value of σ_{mu}. Thus, for lower interfacial strength, the failure, in general will occur at $\sigma \approx 45^{\circ}$, while for $\sigma_{mu} \geq 15 KS_i$, the failure location will shift to point "5" of matrix.

Also, from this study, if $(E_m/E_i) \geq 10.0$, the failure will always occur at $\theta = 90^{\circ}$ and $r = r_f + t_i$, i.e. point "6", as shown in figure 27(b).

3.5 COMPARISON OF THEORY WITH AVAILABLE EXPERIMENTAL DATA FOR A UNIDIRECTIONAL COMPOSITE

Not too many test data are available for a composite subjected to transverse tensile loading. Test data from reference 10 will be used to validate prediction methodologies.

So far, two prediction methodologies have been developed. The first prediction method, developed at section 2, doesn't include the effect of thermal residual stresses (i.e., $\Delta T = 0.0$), while the second prediction method which developed at section 3.4, does include thermal residual stresses. Comparison will be made to evaluate which prediction methodology is more accurate to predict the transverse tensile strength of organic composite materials.

Figure 29 shows the analytical results of these two prediction methodologies as compared with test results. As we can see from the figure, the prediction method without including thermal residual stresses (i.e., $\Delta T = 0.0$) provides better results than the method that includes the effect of thermal residual stresses especially for composites with high fiber volume fraction (i.e., $V_F > .55$).

From a realistic point of view, this phenomena may be possible, because all resin matrix materials exhibit viscoelastic or time-dependent, effects, a significant portion of the thermal residual stresses can be assumed to dissipate through stress relaxation. Additionally, the thermal residual stresses may be reduced through the introduction of transverse matrix microcracking.

3.6 CONCLUSIONS

- Significant thermal residual stresses can be developed in composites during cooldown from curing temperature. In general, the tangential and axial residual stresses are in tension, while the radial residual stress is in compression in most parts of the region.

- The soft interphase increases the tangential residual stress and yet it reduces the radial residual stress. Depending upon the interphase properties, matrix strength, interface strength, and temperature drop, failure locations can be changed from one location to another location.

- Correlation with limited available experimental test data indicates that the prediction methodology that does not include the effects of thermal residual stresses provides better results than the methodology that includes the effects of these stresses.

- The development of thermal residual stresses upon cooling has been shown to degrade the transverse tensile strength of the composite with low interfacial and matrix strength.

4.0 EFFECT OF FIBER-MATRIX INTERPHASE ON THE TRANSVERSE TENSILE STRENGTH OF ORGANIC COMPOSITE WITH INITIAL FLAW

From previous studies, the high stress concentration areas are shown in figure 30. High stress concentration will occur at 'a' or 'b' as long as $(E_m/E_i) \leq (E_m/E_i)_{cr}$ while for $(E_m/E_i) \geq (E_m/E_i)_{cr}$, high stress concentration will occur at 'c'. These three areas will constitute candidate locations for initial crack.

In this study, only the case for initial flaw at location 'a' will be investigated. Figure 31 illustrates the problem to be studied.

4.1 METHOD OF ANALYSIS

From reference 10, the Mode I stress intensity factor can be written as follows

$$K_I = \frac{Y}{\sqrt{\pi a}} \int_{-a}^{a} \sigma_x(l,z) \sqrt{\tfrac{a+z}{a-z}}\, dz \tag{25}$$

where

$a =$ half initial flaw length

$Y =$ correction factor for a finite width plate

$\sigma_x(l,z) =$ local transverse stress on the prospective initial crack with the crack absent for a composite subjected to transverse external load, σ_T, as shown in figure 32.

Assuming K_I^c is the Mode I critical stress intensity factor of the matrix resin, from equation (25) we have

$$K_I^C = \frac{Y}{\sqrt{\pi a}} \int_{-a}^{a} \sigma_x(l,z) \sqrt{\tfrac{a+z}{a-z}}\, dz \tag{26}$$

Denote stress concentration factor as K_s, then

$$\sigma_x(l,z) = K_S(z)\sigma_T \tag{27}$$

where σ_T = external transverse tensile load

Substituting equation (27) into equation (26), we have

$$K_I = \frac{Y\sigma_T}{\sqrt{\pi a}}\int_{-a}^{a} K_s(z)\,\sqrt{\tfrac{a+z}{a-z}}\;dz \tag{28}$$

substituting equation (27) into equation (26), we have the transverse tensile strength of a composite with initial center flaw

$$\sigma_T^C = \frac{\sqrt{\pi a}}{Y}\frac{K_I^C}{\left\{\int_{-a}^{a} K_S(z)\sqrt{\tfrac{a+z}{a-z}}\;dz\right\}} \tag{29}$$

To investigate the influence of the interphase on the transverse tensile strength of a composite with initial flaw, let $\overline{\sigma}_T^c$ represent the transverse tensile strength for a composite with interphase, while $\overline{\overline{\sigma}}_T^c$ represents the transverse tensile strength without interphase. Also, let $\overline{K}_s$ and $\overline{\overline{K}}_s$ represent the local transverse stress concentration factors for composites with interphase and without interphase respectively, then by using equation (29), we have

$$\frac{\overline{\sigma}_T^C}{\overline{\overline{\sigma}}_T} = \frac{\int_{-a}^{a}\overline{\overline{K}}_s(z)\sqrt{\tfrac{a+z}{a-z}}\;dz}{\int_{-a}^{a}\overline{K}_s(z)\sqrt{\tfrac{a+z}{a-z}}\;dz} \tag{30}$$

Equation (31) represents the ratio of the transverse tensile strength of a composite with interphase with respect to a composite without interphase.

Equations (28) and (30) can be evaluated by numerical integration through one dimensional or two dimensional model.

4.1.1 ONE DIMENSIONAL MODEL

From section 2, the stress concentration factor can be expressed as follows:

For a composite with an interphase:

$$K_s = \frac{1}{\left(\frac{\overline{E}_T}{E_m}\right)\left\{1-K_f^*(1-E_m/E_f)-K_i^*(1-E_m/E_i)\right\}} \qquad 0 \le Z \le R$$

$$= \frac{1}{\left(\frac{\overline{E}_T}{E_m}\right)\left\{1-K_i^*(1-E_m/E_i)\right\}} \qquad R \le Z \le R+t_i$$

$$= \frac{1}{\left(\frac{\overline{E}_T}{E_m}\right)} \qquad R+t_i \le Z \le l \tag{31}$$

For $0 \le Z \le R$

$$K_f^* = \frac{R}{l}\left[1-\left(\frac{Z}{R}\right)^2\right]^{1/2}, \quad K_i^* = \frac{R}{l}\left\{\left[\left(1+\frac{t_i}{R}\right)^2-\left(\frac{Z}{R}\right)^2\right]^{1/2}-\left[1-\left(\frac{Z}{R}\right)^2\right]^{1/2}\right\} \tag{32}$$

For $R \le Z \le R+t_i$

$$K_i^* = \frac{R}{l}\left\{\left(1+\frac{t_i}{R}\right)^2-\left(\frac{Z}{R}\right)^2\right\}^{1/2} \tag{33}$$

For a composite without interphase:

$$\overline{\overline{K}}s(z) = \frac{1}{\left(\frac{\overline{\overline{E}}_T}{E_m}\right)\left\{1-k_f^*(1-E_m/E_f)\right\}} \qquad 0 \le Z \le R$$

$$= \frac{1}{\left(\frac{\overline{\overline{E}}_T}{E_m}\right)} \qquad R \le z \le 1 \tag{34}$$

where $\overline{E}_T$ and $\overline{\overline{E}}_T$ = Global transverse stiffness of composites with and without interphase respectively.

Substituting equation (19) and equations (32) through (34) into equations (28) through (30), K_I, σ_T^c and $\overline{\sigma}_T^c / \overline{\overline{\sigma}}_T^c$ can be obtained by numerical integrations.

4.1.2 TWO DIMENSIONAL MODEL

Appendix A shows how local stresses of composites can be obtained by finite element analysis method.

Let $\sigma_x(l,z)$ be the local transverse stresses for a composite subjected to a unit external transverse load, then the Mode I stress intensity factor, k_i, for $\sigma_T = 1.0$ can be written as follows

$$k_I = \frac{Y}{\sqrt{\pi a}} \int_{-a}^{a} \sigma_x(l,z) \sqrt{\tfrac{a+z}{a-z}}\, dz \tag{35}$$

Since the crack is on the boundary line at $x = l$, k_i can be calculated as

$$k_I = \frac{Y}{\sqrt{\pi a}} \quad \sum_{i=1}^{\pi} F_i \left(\frac{a+z_i}{a-z_i} \right)^{1/2} \tag{36}$$

where F_i = boundary nodal force in transverse direction at z_i when a composite subjected to external transverse tensile load equal to σ_T, the total Mode I stress intensity factor can be written as follows

$$K_I = \sigma_T k_I \tag{37}$$

The fracture criterion for a composite with initial flaws will be

$$K_I^C = \sigma_T^C k_I \tag{38}$$

By using same concept as described in section 4.1.1, the influence of interphase on transverse tensile strength for a composite with initial flaw can be written as follows

$$\frac{\overline{\sigma}_T^c}{\overline{\overline{\sigma}}_T^c} = \frac{\overline{\overline{K}}_I}{\overline{k}_I} \tag{39}$$

where $\overline{\sigma}_T^c$, $\overline{\overline{\sigma}}_T^c$ = transverse tensile strength for a composite with and without interphase respectively

$\overline{k}_I$, $\overline{\overline{k}}_I$ = Mode I stress intensity factor under unit external load for a composite with and without interphase respectively

4.2 VALIDATION AND ANALYTICAL RESULTS

4.2.1 COMPARISON OF ONE DIMENSIONAL AND TWO DIMENSIONAL MODELS

Transverse tensile strength ratio for composites with and without interphase for various initial size have been calculated by using one dimensional model and the two dimensional model as described in section 4.1.1 and 4.1.2. Figure 32 shows the comparison of results from one dimensional analysis and two dimensional analysis. The correlation between these two methods is excellent as can be seen from the figure. Due to the simplicity and accuracy of one dimensional model, it is recommended to be used for design analysis of composite with initial flaws.

4.2.2 ANALYTICAL RESULTS

Mode I stress intensity factors for $\sigma_T = 1.0\ N/\mu m^2$ for composites with interphase and without interphase are shown in figure 34 and figure 35. From these figures it can be seen that Mode I stress intensity increases as initial flaw size increases, this means that the stability of the propagation of the initial flaw which located at the

center of matrix between two fibers is unstable. The initial flaw will grow into failure or arrested depending upon geometric and stiffness properties of fiber, matrix and interphase. Also from figure 36, one can see that soft interphase improves the transverse tensile strength of the composite greatly if the fiber volume fraction is large and initial flaw size is small. For composites with high fiber volume fraction, the interphase has little influence on the transverse tensile strength of composites when the initial flaw is as large as fiber radius.

Figure 37 shows that for a composite with lesser transverse stiffness ratio between fiber and matrix, the interphase also improves the transverse tensile strength of the composite but with lesser degree of increase.

Figures 38 and 39 show the influence of interphase on the transverse tensile strength of composites with various initial flaw sizes. It can be seen that for fiber volume fraction equal to .4 or less, the sizes of initial flaw have insignificant effect on transverse tensile strength of composites.

4.3 CONCLUSIONS

- The stability of the propagation of the initial flaw which is located at the middle of the matrix between two fibers is unstable.
- The soft interphase improves the transverse tensile strength of composites, especially when flaw size is small and fiber volume fraction is large. For composites with smaller fiber volume fraction (i.e., $V_F \leq .4$), the influence of flaw size on the transverse tensile strength is insignificant.

5.0 GUIDELINES FOR THE IMPROVEMENT OF THE TRANSVERSE TENSILE STRENGTH OF ORGANIC COMPOSITES

In the section, guidelines to improve the transverse tensile strength of organic composites through tailoring interphase properties and thickness will be provided. From conclusions of section 3.0, the thermal residual stresses are not included in the guidelines. Only guidelines for interphase properties of composites without initial flaw will be considered in this study.

From equation (16), the maximum local transverse tensile stress for a composite with interphase can be written as follows

$$\text{For } \left(\frac{E_m}{E_c}\right) \leq \left(\frac{E_m}{E_c}\right)_{cr} : \ \bar{\sigma}_L = \bar{\sigma}_T \left(\frac{E_m}{\overline{E}_T}\right) \frac{}{\left\{1-\overline{K}_f(1-E_m/E_f)-\overline{K}_i(1-E_m/E_i)\right\}} \tag{40}$$

$$\overline{K}f = Kf = \left(\frac{4V_F}{\pi}\right)^{1/2}, \quad \overline{K}_i = \left(\frac{4V_F}{\pi}\right)^{1/2} \frac{t_i}{R}, \quad \frac{R}{l} = \left(\frac{4V_F}{\pi}\right)^{1/2} \tag{41}$$

where

$$\frac{\overline{E}_T}{E_m} = \frac{1}{l}\left\{\int_O^R \frac{l \qquad dz}{\left[1-K_i^*(1-E_m/E_i)-K_f^*(1-E_m/E_f)\right]} + \int_R^{R+ti} \frac{dz}{\left[1-(1-E_m/E_i)K_i^*\right]} + l-(R+ti)\right\} \tag{42}$$

For $0 \leq Z \leq R$

$$K_f^* = \frac{R}{l}\left[1-\left(\frac{Z}{R}\right)^2\right]^{1/2}, \quad K_i^* = \frac{R}{l}\left\{\left[\left(1+\frac{t_i}{R}\right)^2 - \left(\frac{Z}{R}\right)^2\right]^{1/2} - \left[1-\left(\frac{Z}{R}\right)^2\right]^{1/2}\right\} \tag{43}$$

For $R \leq Z \leq R+t_i$

$$K_i^* = \frac{R}{l}\left\{\left(1+\frac{t_i}{R}\right)^2 - \left(\frac{Z}{R}\right)^2\right\}^{1/2} \tag{44}$$

$$\left(\frac{E_m}{E_i}\right)_{Cr} = 1.0 + \left\{1 - (E_m/E_f)\right\} / (t_i/R) \tag{45}$$

Assume σ_0 is the failure stress either at matrix or at fiber-matrix interface, then the transverse tensile strength of the composite can be written as follows

$$\overline{\sigma}_T^C = \left(\frac{\overline{E}_T}{E_m}\right) \sigma_0 \left\{ \left(1 - \overline{K}_f - \overline{K}_i\right) + \overline{K}_f \left(\frac{E_m}{E_f}\right) + Ki \left(\frac{E_m}{E_i}\right) \right\} \tag{46}$$

For a composite without interphase, the transverse tensile strength can be written as follows

$$\overline{\overline{\sigma}}_T^C = \left(\frac{\overline{\overline{E}}_T}{E_m}\right) \sigma_0 \left\{ \left(1 - \overline{K}_f\right) + \overline{K}_f \left(\frac{E_m}{E_f}\right) \right\} \tag{47}$$

where

$$\frac{\overline{\overline{E}}_T}{E_m} = \left\{ \frac{1}{l} \int_O^R \frac{dz}{\left[1 - K_f^*(1 - E_m/E_f)\right]} + 1 - \left(\frac{4V_f}{\pi}\right)^{1/2} \right\} \tag{48}$$

The influence of interphase properties and thickness on the transverse tensile strength of composites can be expressed as follows

$$\left(\frac{\overline{\sigma}_T^C}{\overline{\overline{\sigma}}_f^c}\right) = \frac{\left(\frac{\overline{E}_T}{E_m}\right) \left\{ \overline{K}_f \left(\frac{E_m}{E_f}\right) + \overline{K}_i \left(\frac{E_m}{E_c}\right) + \left(1 - \overline{K}_f - \overline{K}_i\right) \right\}}{\left(\frac{\overline{\overline{E}}_T}{E_m}\right) \left\{ \overline{K}_f \left(\frac{E_m}{E_f}\right) + \left(1 - \overline{K}_f\right) \right\}} \tag{49}$$

Equation (49) is used to provide design charts for interphase tailoring to obtain desired transverse tensile strength for $\left(\frac{E_m}{E_i}\right) \leq \left(\frac{E_m}{E_i}\right)_{cr}$.

For $\left(\frac{E_m}{E_i}\right) \leq \left(\frac{E_m}{E_i}\right)_{cr}$:

The maximum local transverse stress will occur $\theta = 90^\circ$ and $r = R_f + t_i$.

$$\bar{\sigma}_L = \bar{\sigma}_T \left(\frac{E_m}{\bar{E}_T} \right) \tag{50}$$

The transverse tensile strength of the composite will be

$$\bar{\sigma}_T^c = \bar{\sigma}_O \left(\frac{\bar{E}_T}{E_m} \right) \tag{51}$$

From equation (47) and (51) we have

$$\left(\frac{\bar{\sigma}_T^c}{\bar{\bar{\sigma}}_T^c} \right) = \frac{\left(\frac{\bar{E}_T}{E_m} \right)}{\left(\frac{\bar{\bar{E}}_T}{E_m} \right) \left\{ \left(1 - \bar{K}_f \right) + \bar{K}_f \left(\frac{E_m}{E_f} \right) \right\}} \tag{52}$$

Equation (52) is used to provide design charts for interphase tailoring to obtain desired transverse tensile strength for $\left(\frac{E_m}{E_c}\right) > \left(\frac{E_m}{E_i}\right)_{cr}$.

Typical design charts based on equation (49) and equation (52) are shown in figures 40 through 42. All the design charts are shown in Appendix C for reference.

To apply these design charts, composite designers should know in advance how much percentage of strength improvement is required, then use these charts to determine feasible and adequate interphase property and thickness to meet the requirement. Also, the designer should know that for $\left(\frac{E_m}{Ec}\right) \le \left(\frac{E_m}{Ec}\right)_{cr}$, the failure occurs at $\theta = 0^\circ$ and $R \le r \le R + t_i$, while for $\left(\frac{E_m}{E_i}\right) > \left(\frac{E_m}{E_i}\right)_{cr}$, the failure occurs at $\theta = 90^\circ$ and $r = R + t_i$.

6.0 CONCLUSIONS

- To increase transverse tensile strength of a composite, the interphase modulus should be decreased and/or the interphase thickness should be increased.
- The mode and location of failures may be changed by changing the interphase modulus and thickness.
- Correlation with limited available experimental test data indicates that the prediction methodology that does not include the effects of thermal residual stresses provides better results than the methodology that includes the effects of these stresses.
- In order to improve the transverse tensile strength of the composite, guidelines for the selection of appropriate interphase properties were developed and design charts were provided.

REFERENCES

1. L.B. Greszczuk, "Theoretical and Experimental Studies on Properties and Behavior of Filamentary Composite," Society of Plastics Industry, 21st Annual Conference, Washington, D.C., 1966.

2. D.F. Adams and D.R. Doner, "Transverse Normal Loading of a Unidirectional Composite," Journal of Composite Materials, 1,152, 1967.

3. D.F. Adams, "A Micromechanics Analysis of the Influence of the Interface on the Performance of Polymer Matrix Composites," proceedings of the American Society for Composites, First Technical Conference, 1986.

4. L.T. Drzal, "Tough Composite Materials: Recent Developments," Noyes, Park Ridge, New Jersey, pp. 207–222, 1985.

5. M.R. Piggott, "Polymer Composite," B(5), pp. 291–296, 1987.

6. H.C. Tsai, A.M. Arocho, L.W. Gause, "Prediction of Fiber-Matrix Interphase Properties and Their Influence on Interface Stress, Displacement and Fracture Toughness of Composite Material," To be published in Materials Science and Engineering, A126, pp. 295–304, 1990.

7. J.F. Mandell, etc., "Modified Microdebonding Test for Direct In Situ Fiber/Matrix Bond Strength Determination in Fiber Composite," Composite Materials: Test and Design," ASTM STP 893, pp. 87–108, 1986.

8. D.F. Adams, and S.W. Tsai, "The Influence of Random Filament Packing on the Transverse Stiffness of Unidirectional Composite," Journal of Composite Materials, Volume 3, pp. 368–381, July 1969.

9. A.M. Skuda, "Micromechanics of Failure of Reinforced Plastics." Failure Mechanics of Composites, p. 18, Volume 3, Handbook of Composites, North-Holland, 1986.

10. P.C. Paris and G.C. Sih, "Stress Analysis of Cracks," in "Fracture Toughness Testing and its applications," ASTM STP No. 381, ASTM, Philadelphia, 1965.

TABLE I. COMPARISON OF 1-D AND 2-D ANALYTICAL RESULTS

$$E_f/E_m = 21.3,\ V_F = 0.65,\ t_i/R = .015$$

S.C.F

E_m/E_i / METHOD	1.0	10.0	15.0	20.0	30.0	40.0	50.0
1-D	1.905	1.651	1.582	1.531	1.460	1.410	1.371
2-D	2.019	1.716	1.643	1.592	1.519	1.459	1.412
1-D/2-D	.944	.962	.963	.962	.961	.966	.971

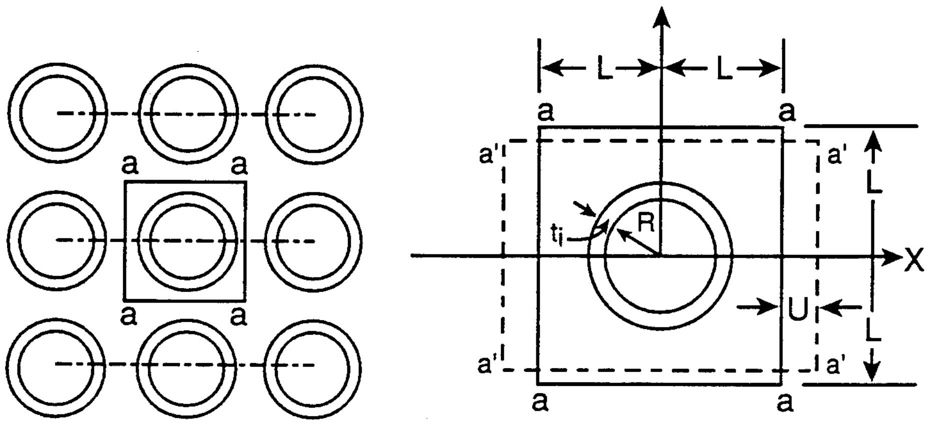


Figure 1. Fiber Packing Geometries.

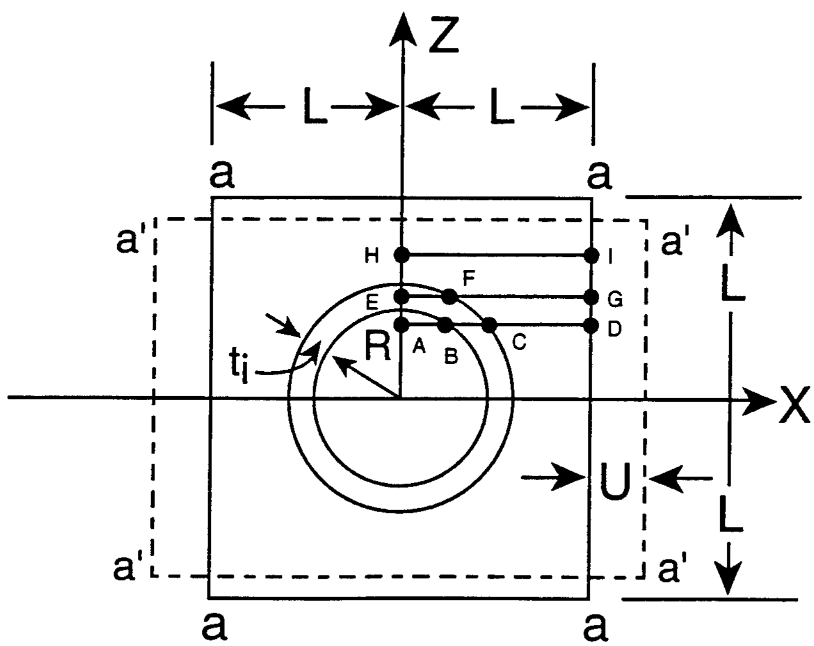


Figure 2. One-Dimensional Model for the Composite Under Transverse Tensile Loading.

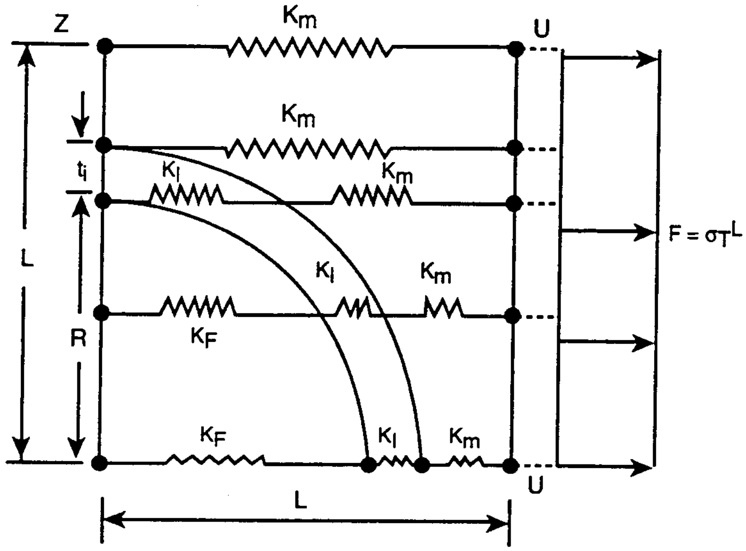


Figure 3. Basic Concept for One-Dimensional Model.

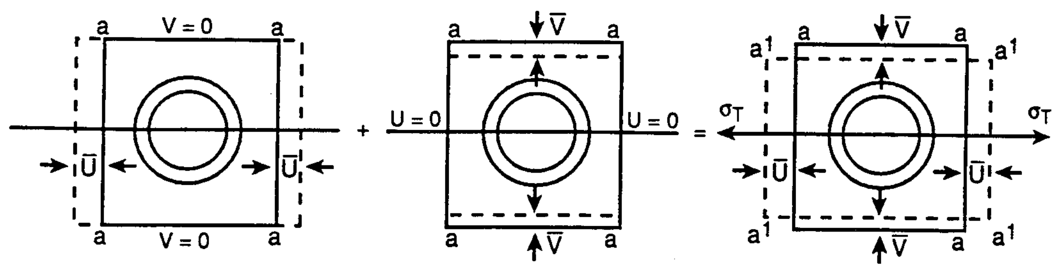


Figure 4. Basic Concept for Two-Dimensional Model.

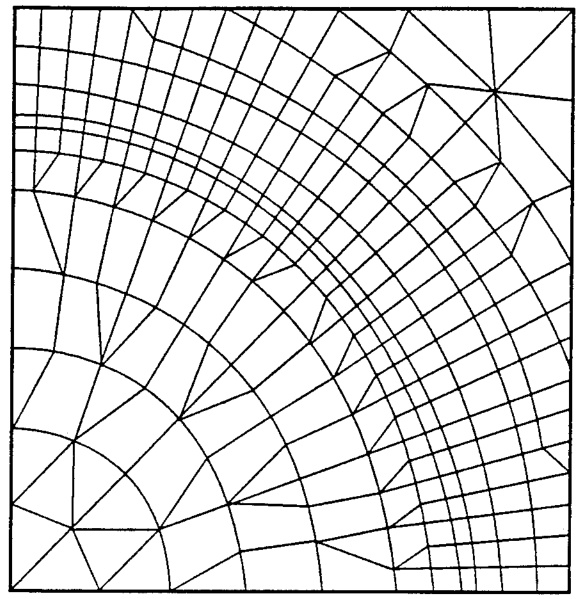


Figure 5. Two-Dimensional Finite Element Model.

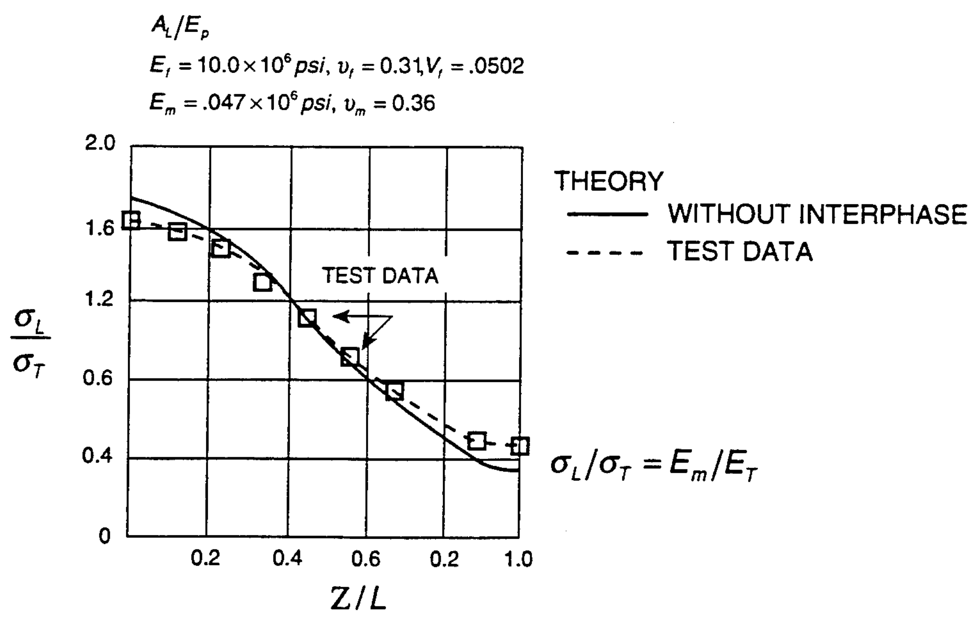


Figure 6. Transverse Tensile Stress Distribution Along X = L; Test vs. One-Dimensional Theory.

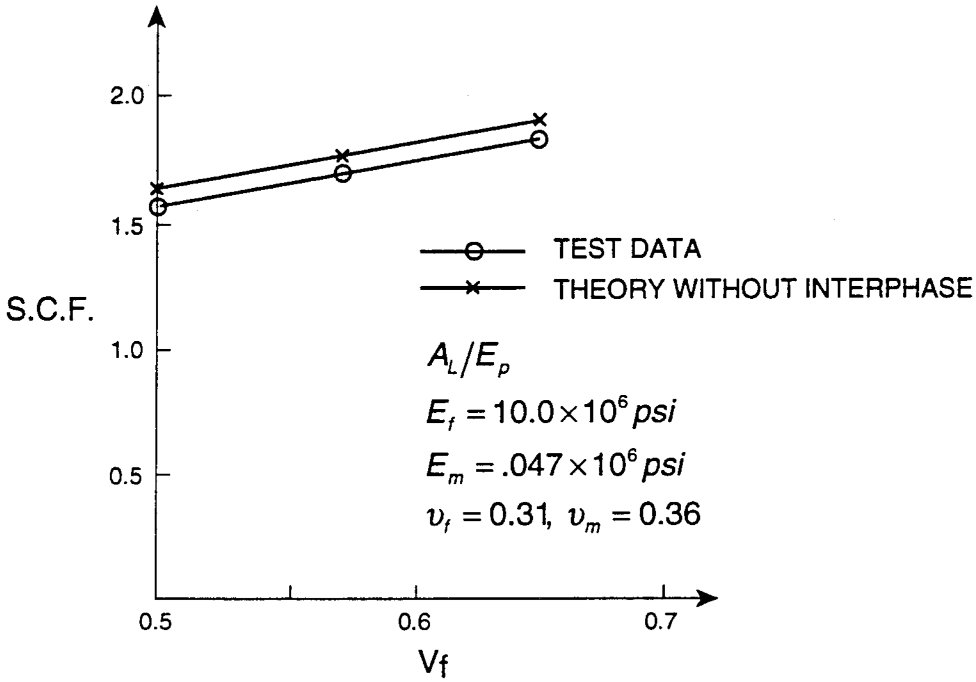


Figure 7. Maximum Transverse Tensile Stress; Theory vs. Test.

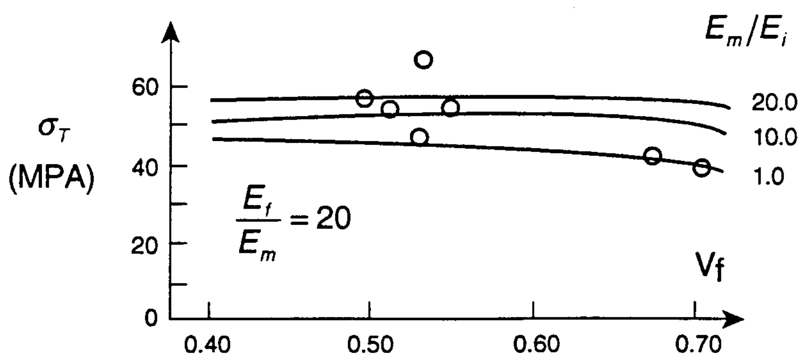


Figure 8. Correlation of 1-D Theory with Test Data For Gl/Ep Composite.

$$\left(\sigma_{m1} = 74.2 MPA,\ t_i/R = 0.286\right)$$

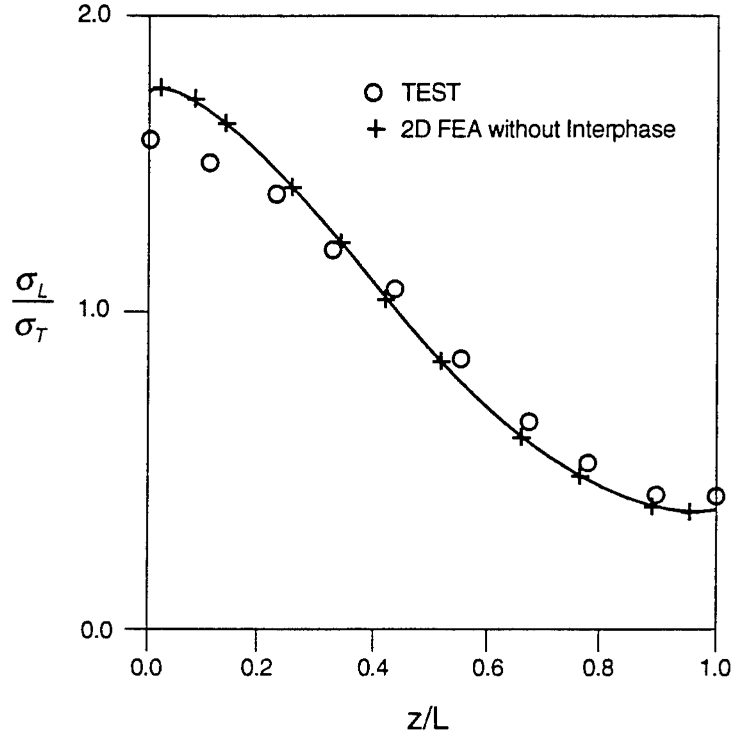


Figure 9. Transverse Tensile Stress Distribution Theory vs. Test, $V_F = .502$.

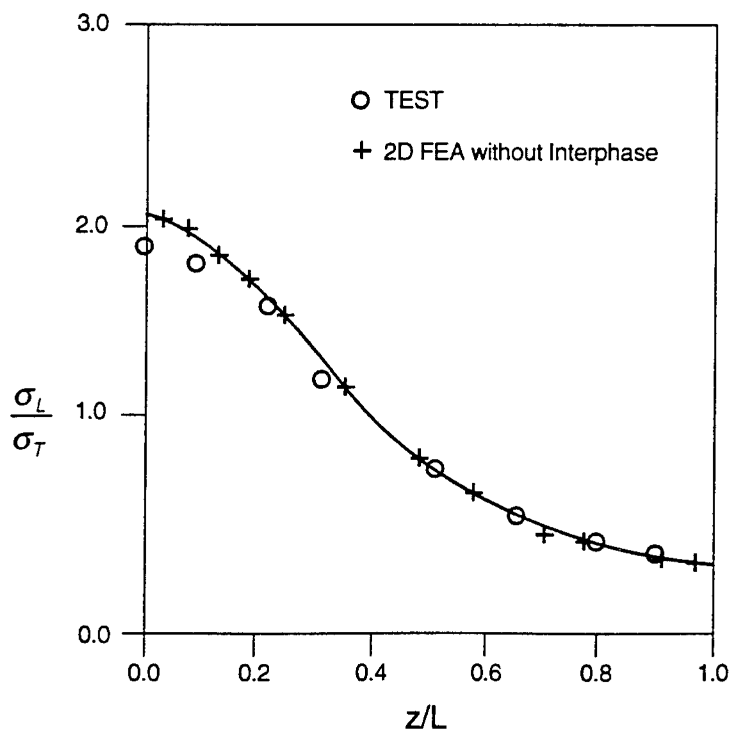


Figure 10. Transverse Tensile Stress Distribution Theory vs. Test $V_F = .65$.

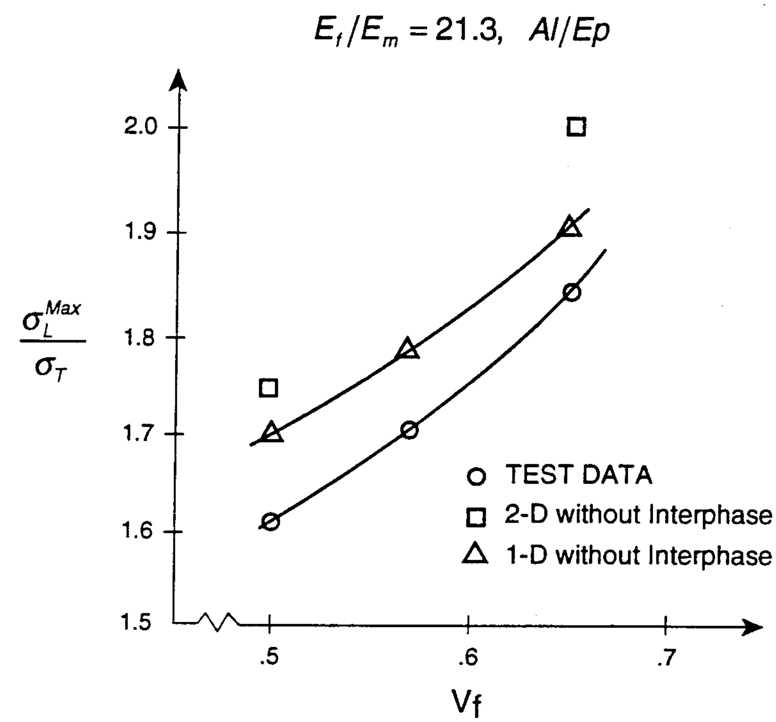


Figure 11. Maximum Transverse Tensile Stress Theories vs. Test.

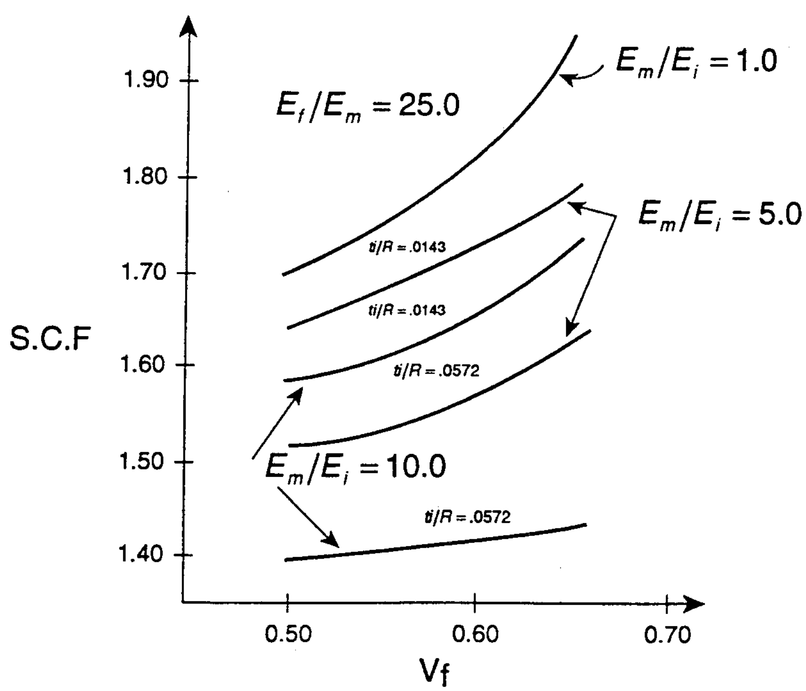


Figure 12. Effect of Interphase Moduli and Thickness on S.C.F. of the Composite.

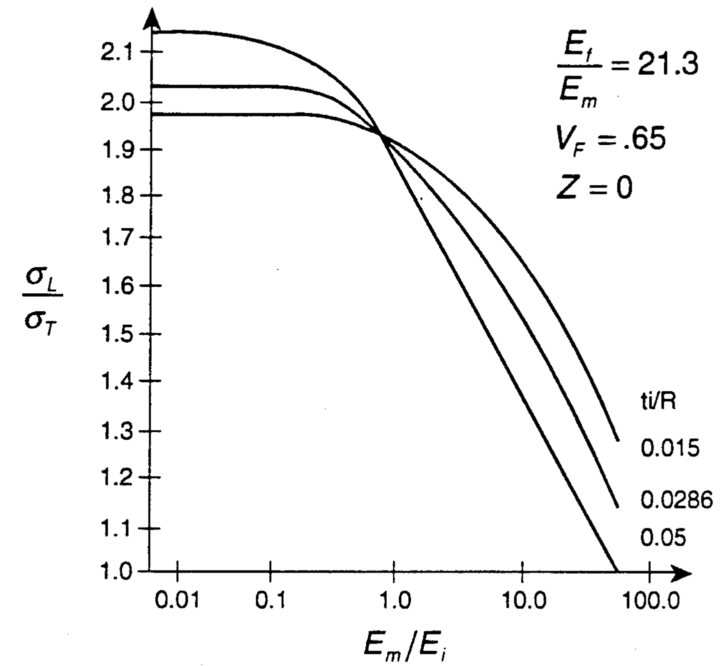


Figure 13. $\frac{\sigma_L}{\sigma_T}$ vs. $\frac{E_m}{E_i}$ with Various Interphase Thickness.

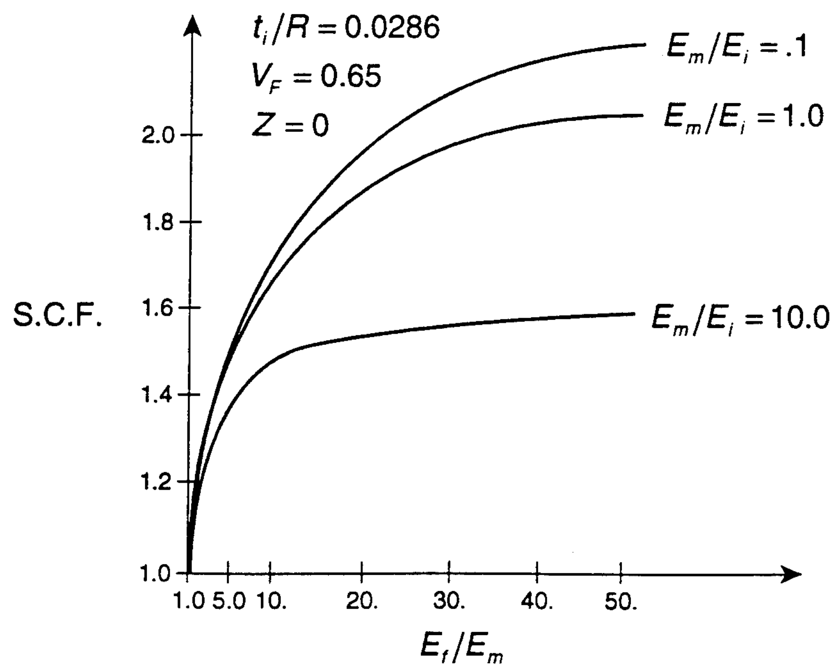


Figure 14. Effect of E_f/E_L and E_m/E_i on the Maximum Stress Concentration Factor.

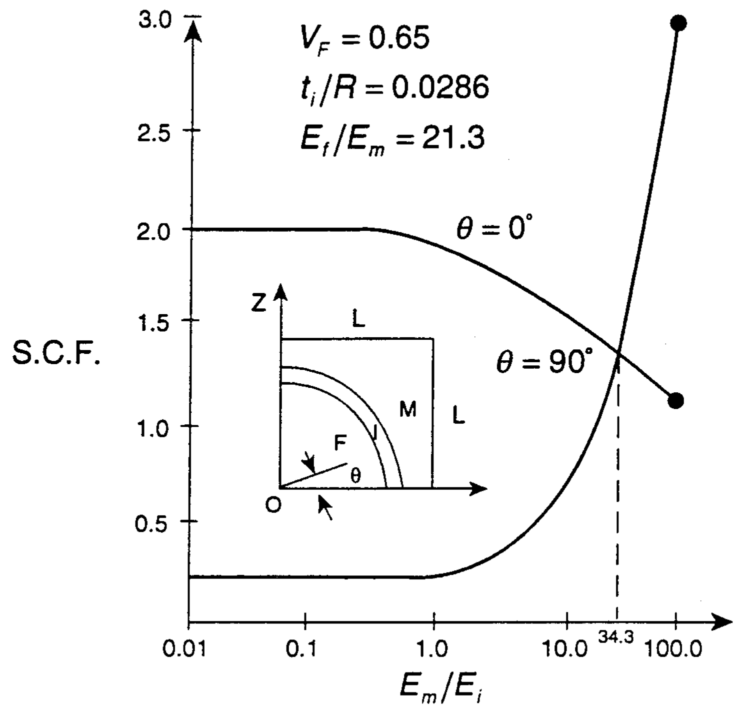


Figure 15. The Shift of the Critical Location.

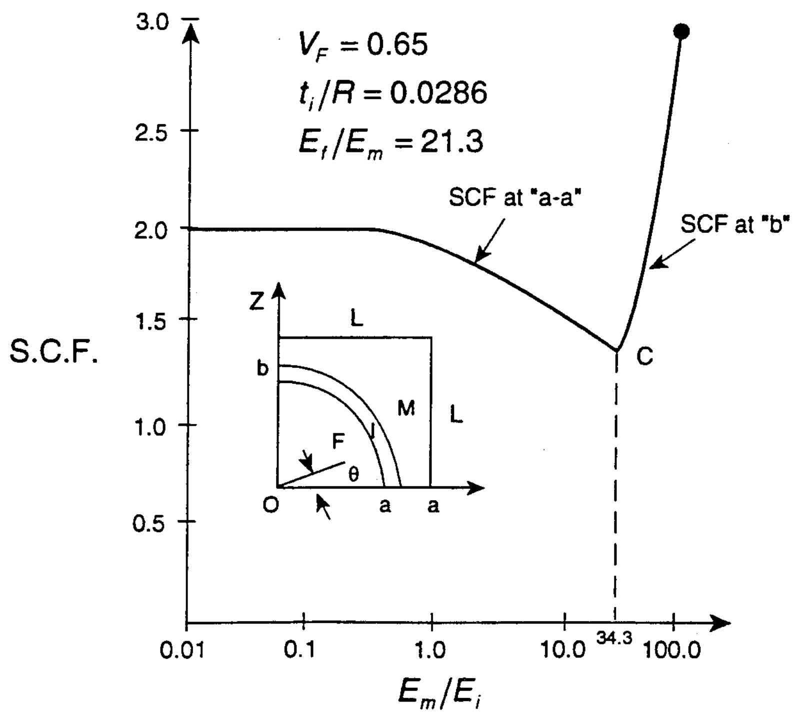


Figure 16. Critical Stress Concentration Factors as Functions of Interphase Moduli.

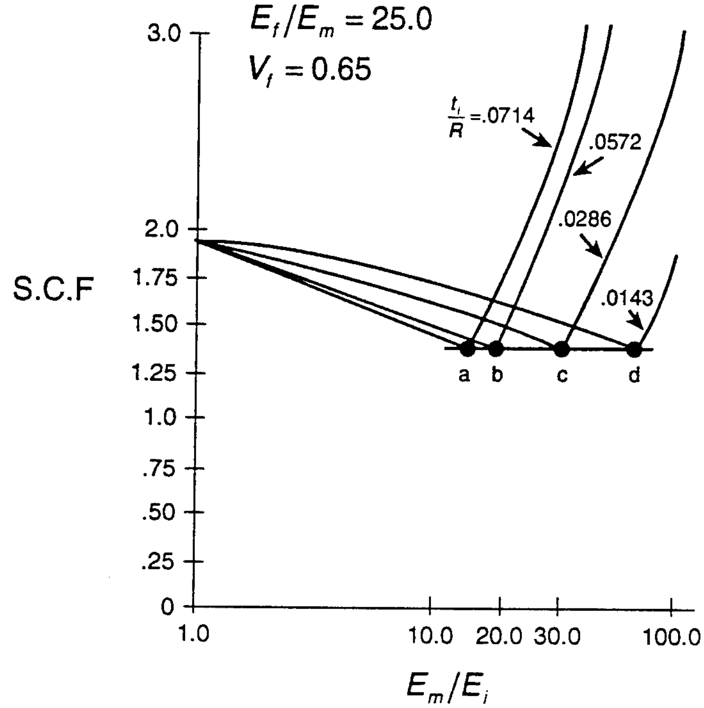


Figure 17. Critical Stress Concentration Factors as Functions of Interphase Moduli and Thickness.

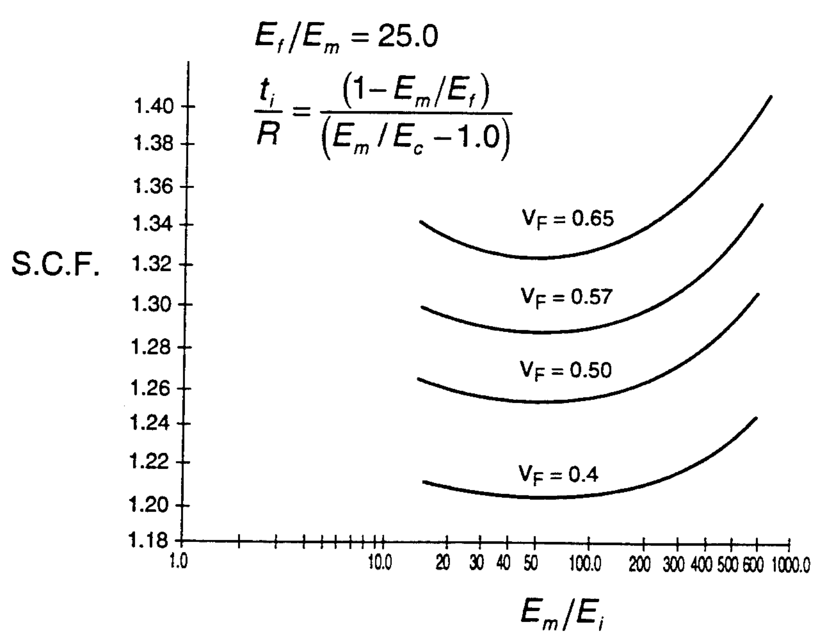


Figure 18. Design Curves for Optimal Interphase Modulus and Thickness.

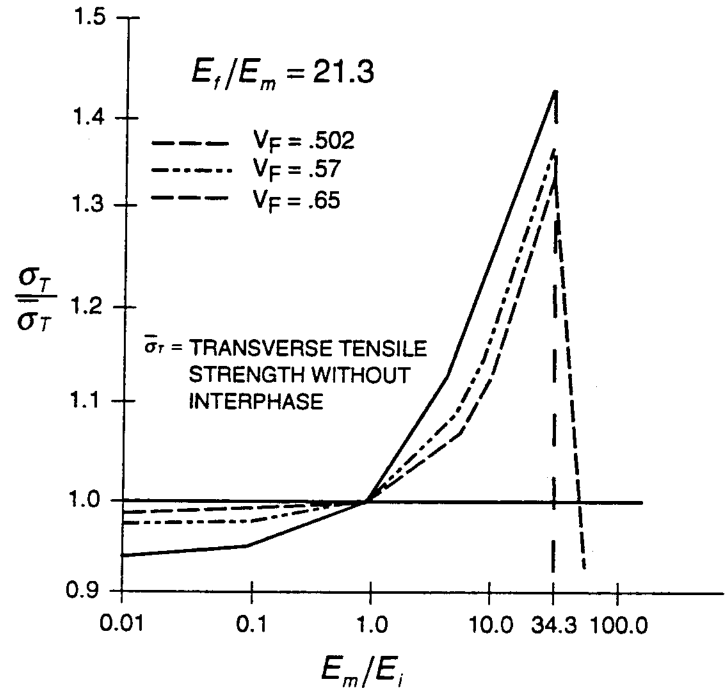


Figure 19. Effect of Interphase Moduli on the Transverse Tensile Strength of Composite Material.

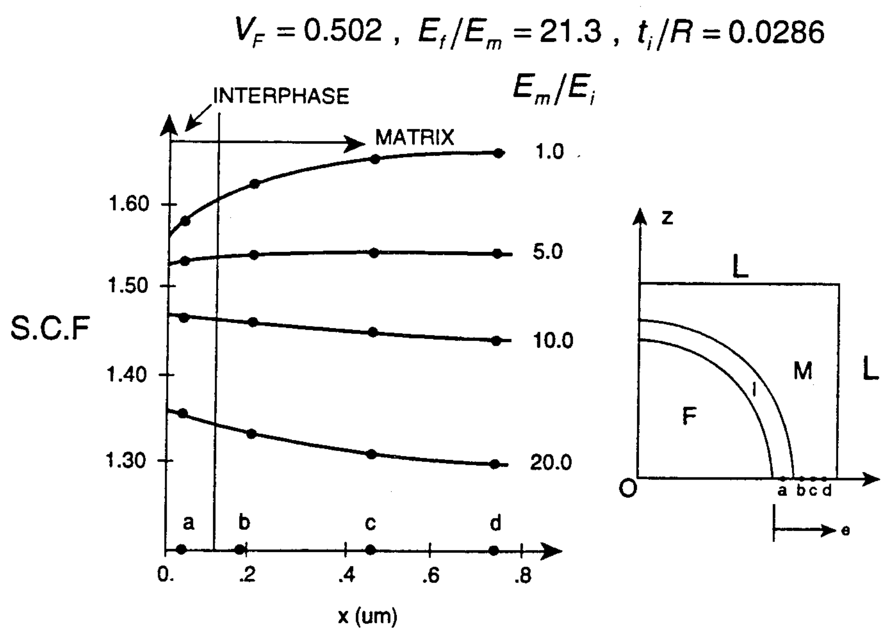


Figure 20. Stress Distribution in the Interphase and Matrix at $Z = 0.0$, as Function of Interphase Moduli.

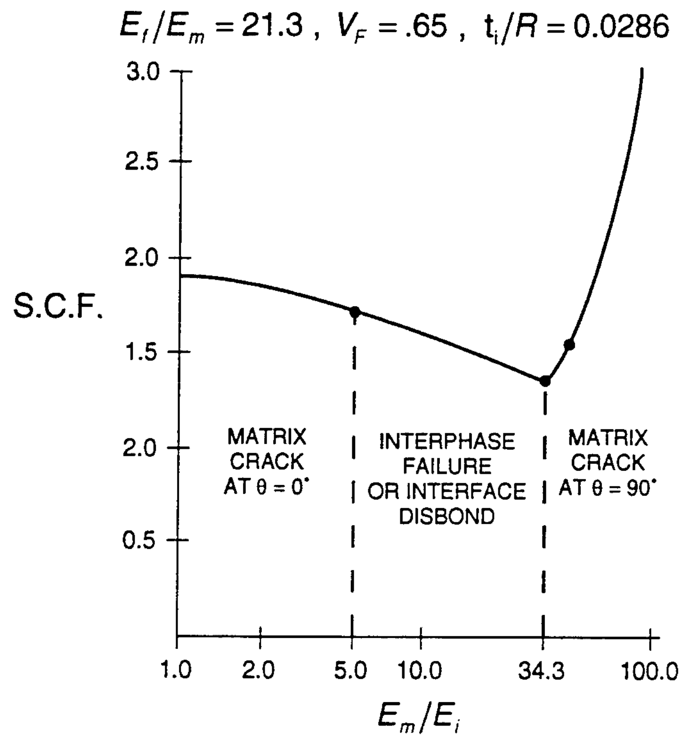


Figure 21. Design Curve for Transverse Tensile Failure of the Composite Material.

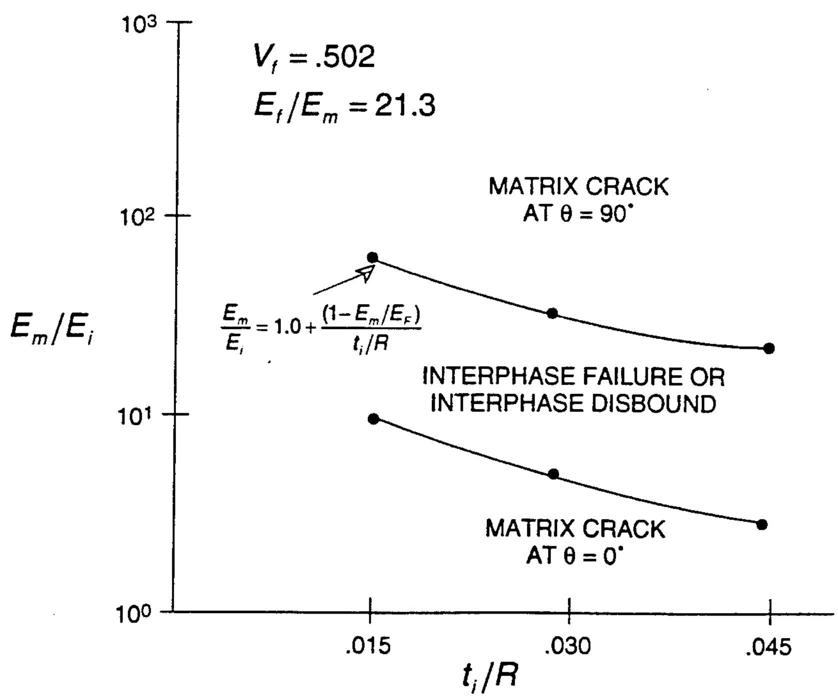
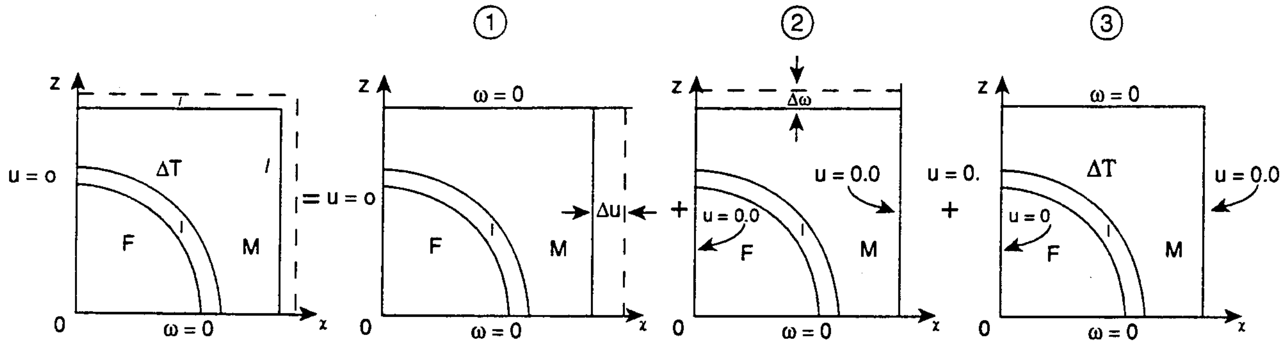


Figure 22. Effect of Interphase Modulus and Thickness on the Transverse Failure Mode of the Composite.



$$\alpha\int_o^l \sigma_x \, dz + \beta\int_0^l \sigma_x \, dz + \int_o^l \sigma_x \, dz = 0. \text{ at } x = l$$

$$\alpha\int_o^l \sigma_z \, dx + \beta\int_0^l \sigma_z \, dx + \int_o^l \sigma_x \, dx = 0. \text{ at } x = l$$

$$\sigma_{ij} = \alpha\sigma_{ij} + \beta\sigma_{ij} + \sigma_{ij}$$

Figure 23. Micromechanical Model for Thermal Stress Analysis.

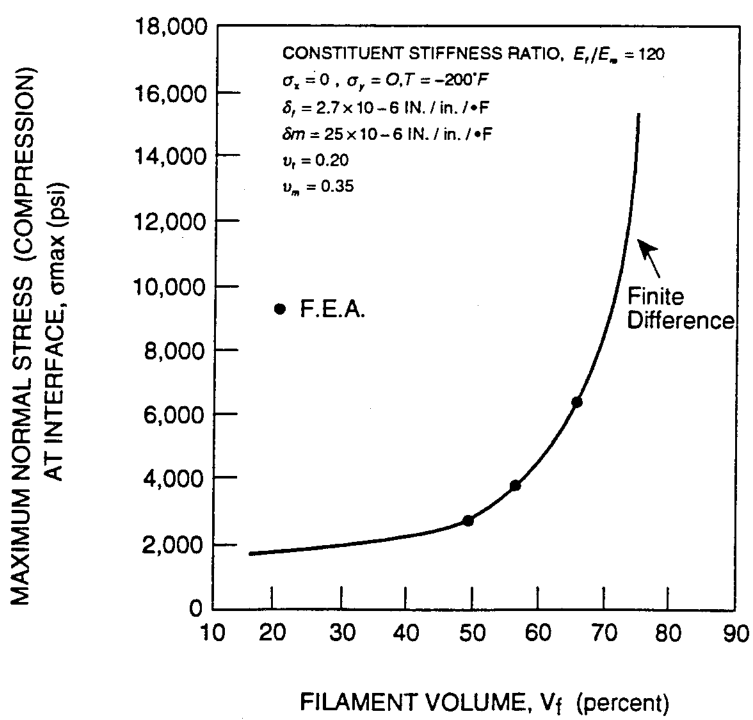


Figure 24. Validation of Thermal Residual Stress.

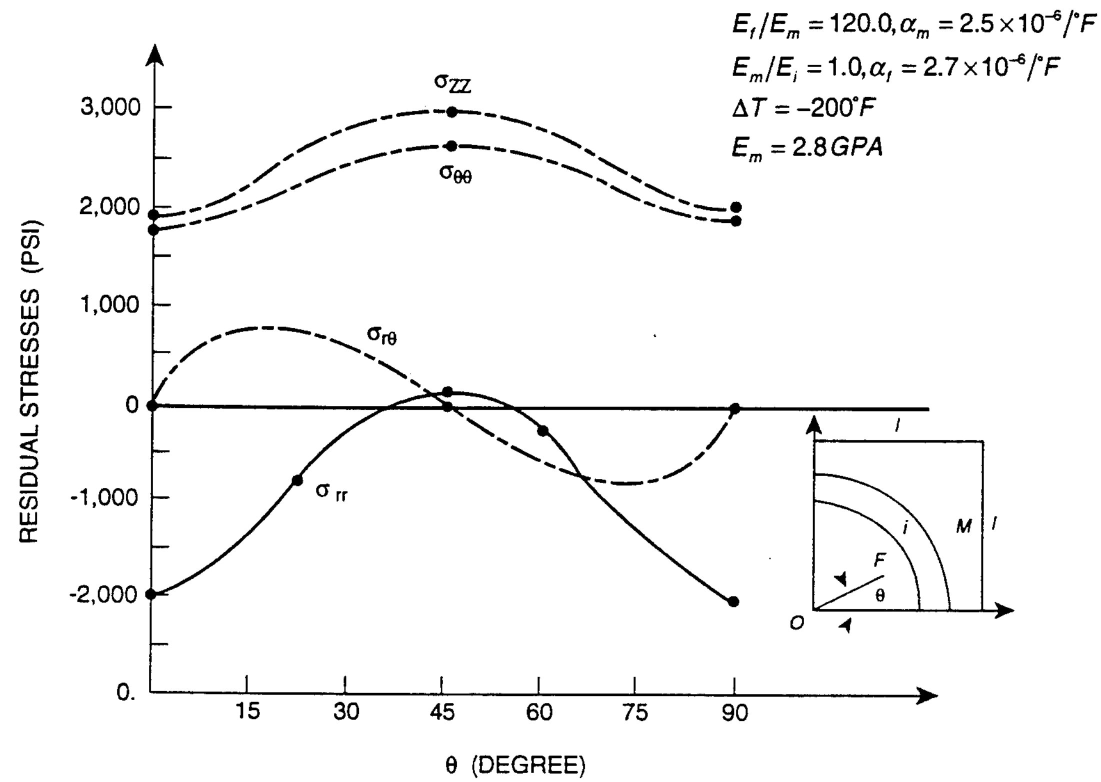


Figure 25. Residual Stresses at Interface, $V_F = .50$.

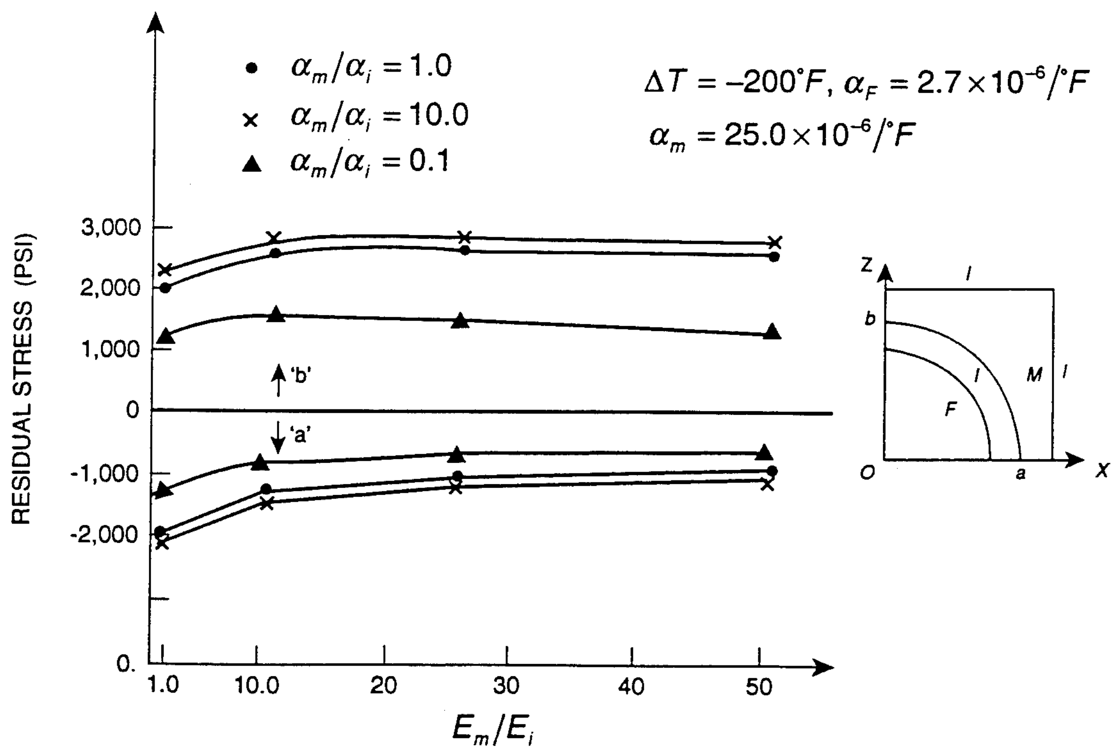
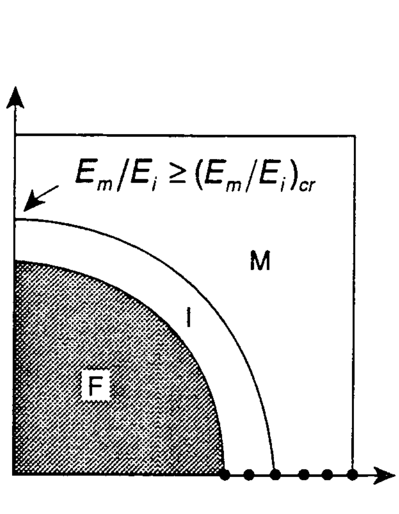


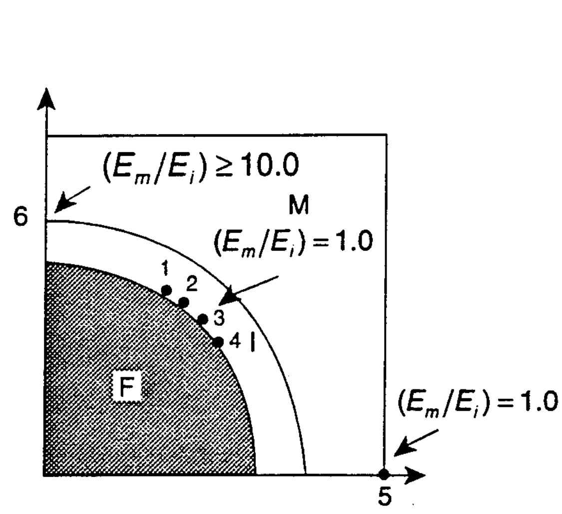
Figure 26. Effect of Interphase Properties on the Transverse Thermal Residual Stress of the Composite.

$(V_f = .5\ ,\ E_f/E_m = 120\ ,\ t_i/R = .0286)$



Thermal Residual Stresses Not Inlcuded

(a)



Thermal Residual Stresses Inlcuded
(ΔT = -280 °F)

(b)

Figure 27. Failure Locations for Composites Subjected to Transverse Tensile Load.

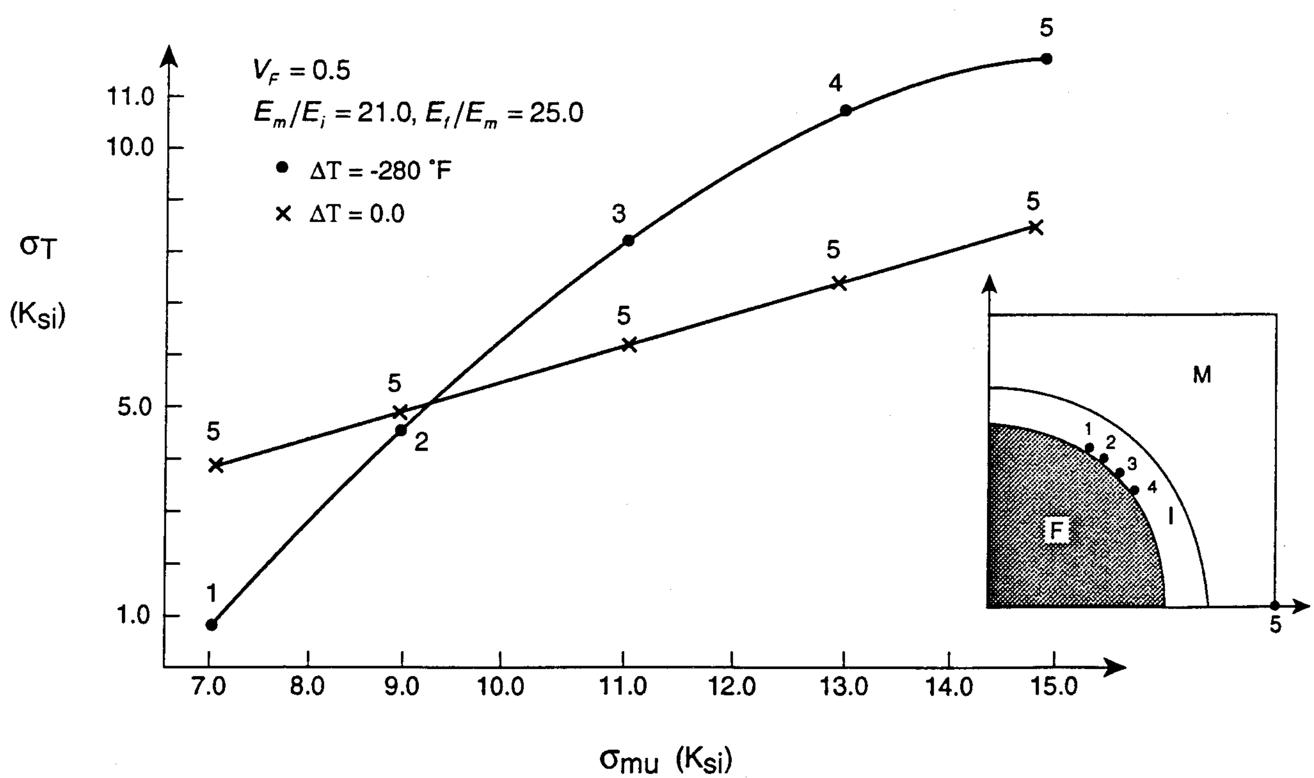


Figure 28. Effect of Matrix Strength on the Transverse Tensile Strength of Composites with Thermal Residual Stresses.

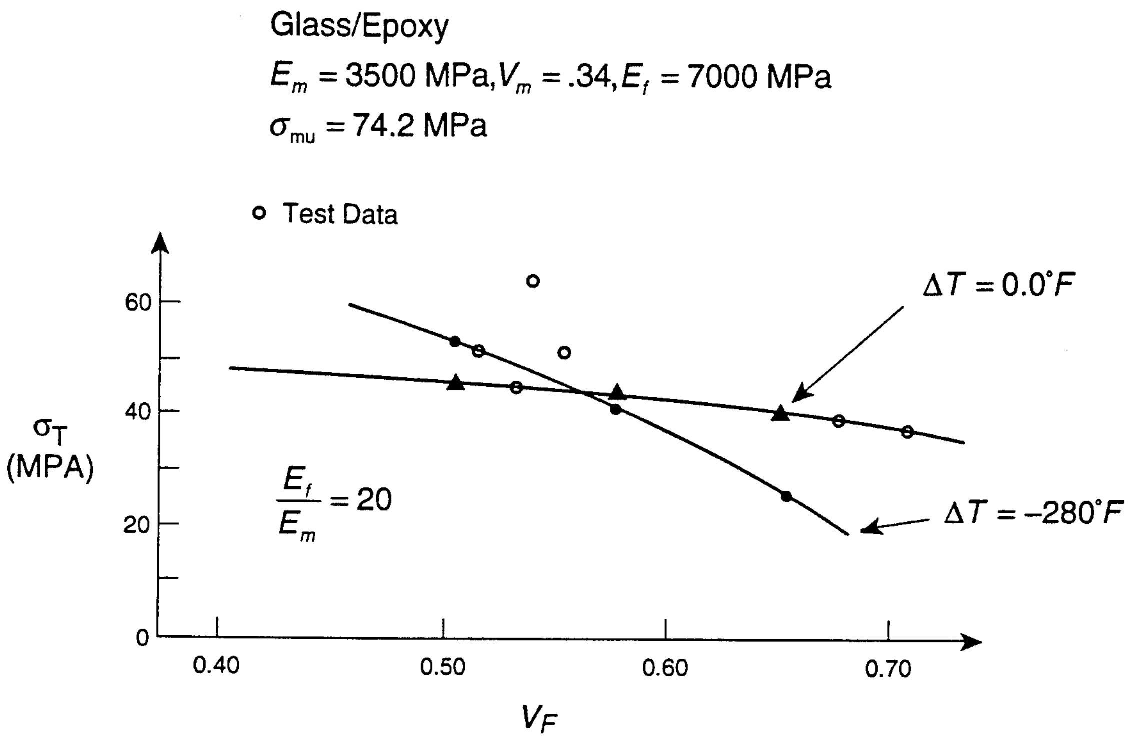


Figure 29. Comparison of Two Transverse Tensile Strength Prediction Methodologies (Test Data from Ref. 10).

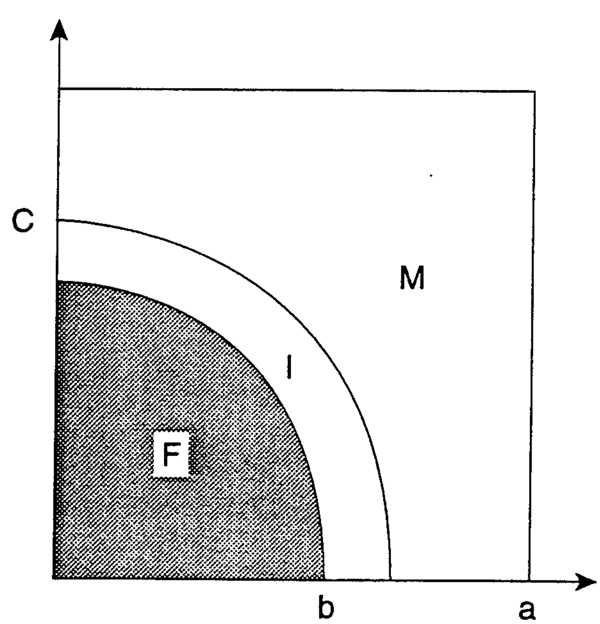


Figure 30. Candidate locations for Initial Flaws.

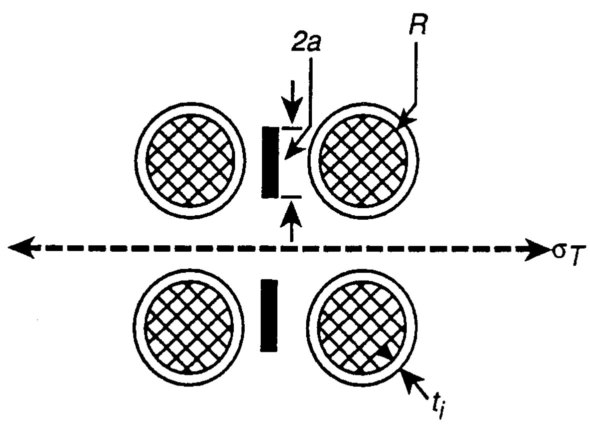
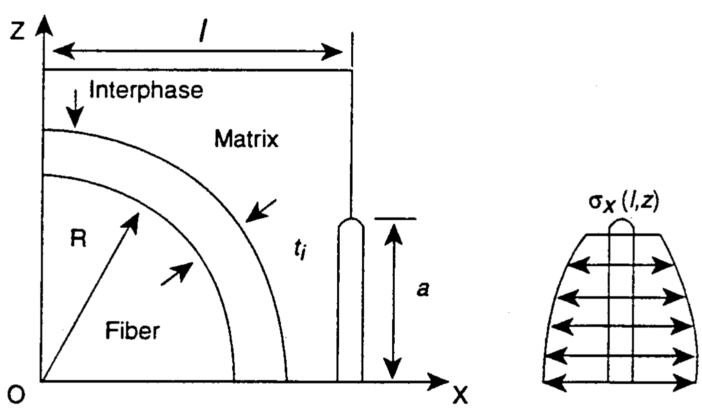


Figure 31. Composite with Initial Flaw at Center of Matrix Between Fibers.



K_I = Mode I Stress Intensity Factor

$$K_I = \frac{Y}{\sqrt{\pi a}} \int_{-a}^{a} \sigma_x (l,z) \sqrt{\frac{a+z}{a-z}}\, dz$$

Figure 32. Mode I Stress Intensity Factor for a Composite with Initial Flaw.

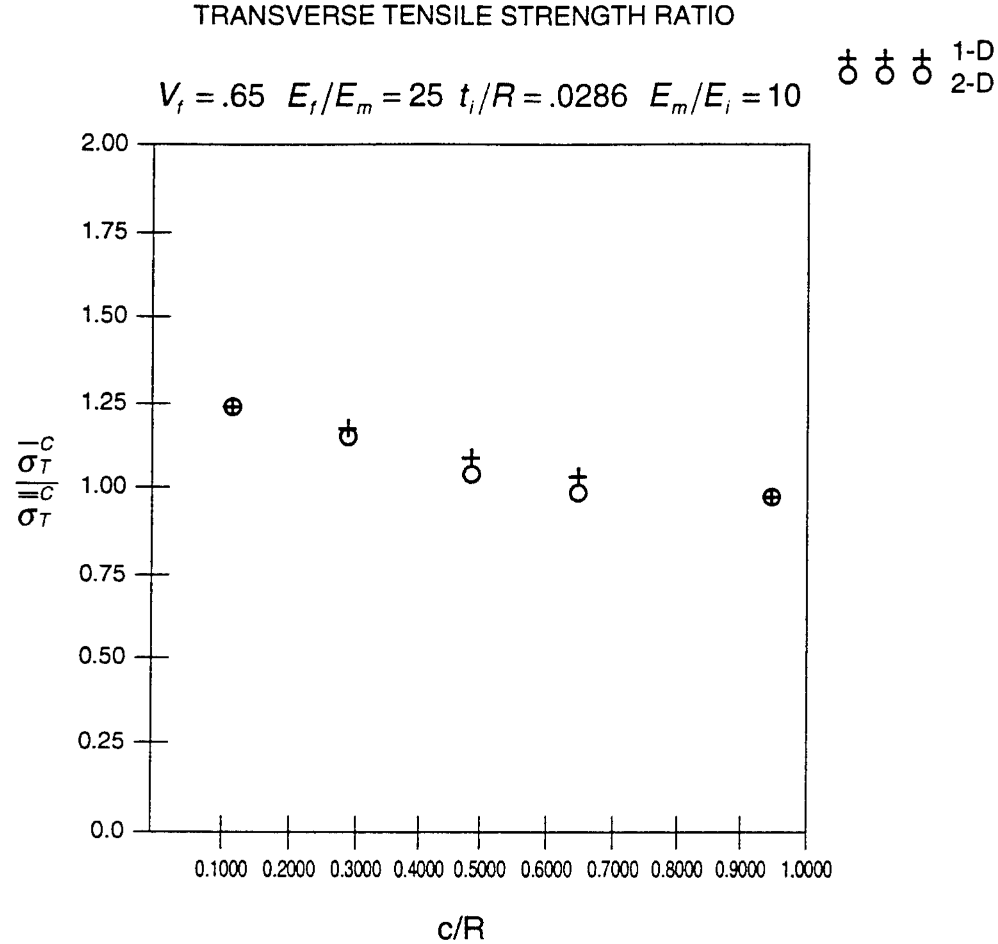


Figure 33. Comparison of One Dimensional Model and Two Dimensional Model.

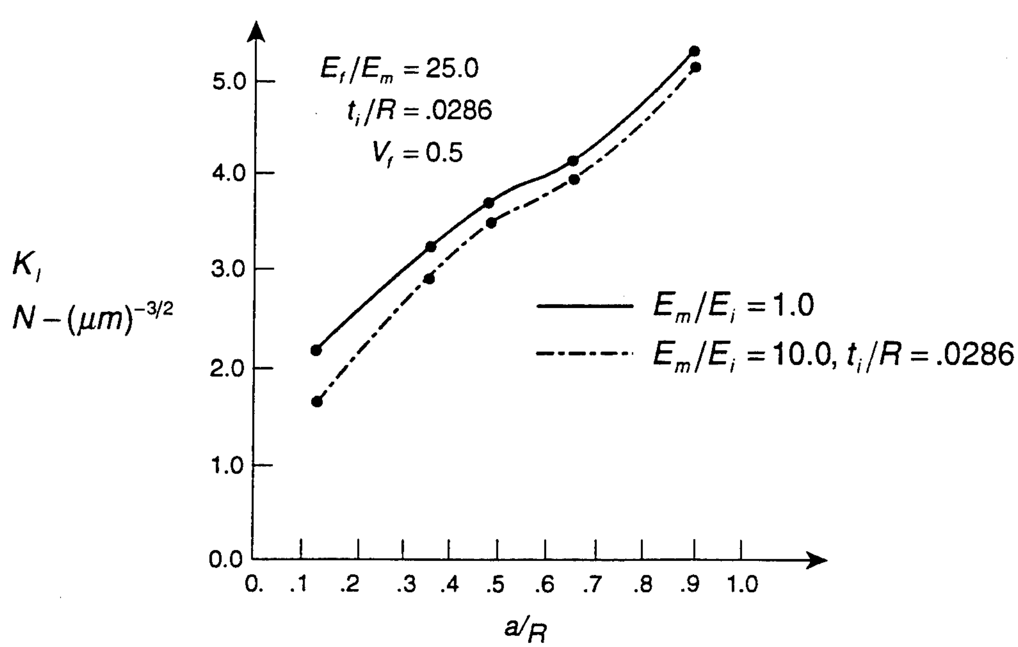


Figure 34. Mode I Stress Intensity Factor for $\sigma_T = 1.0$ N/υm² and $V_f = .5$.

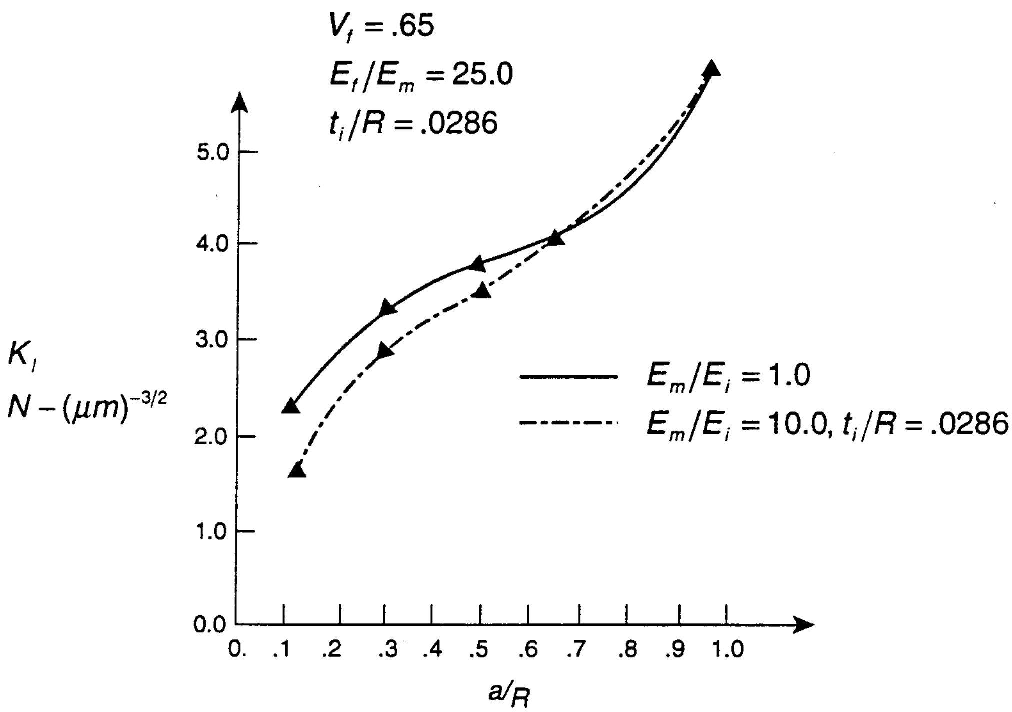


Figure 35. Mode I Stress Intensity Factor for $\sigma_T = 1.0$ N/µm2 and $V_f = 6.5$.

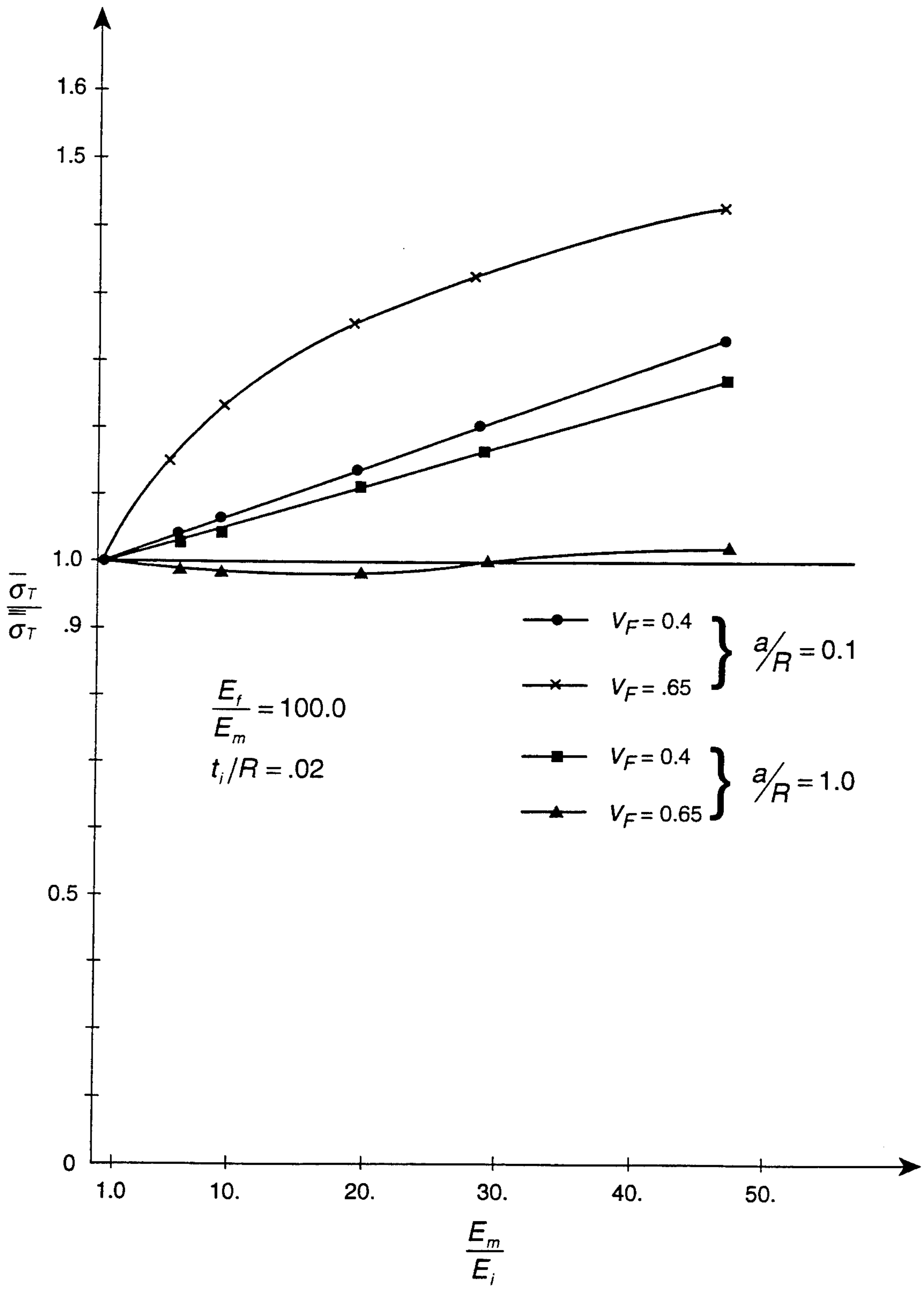


Figure 36. Influence of Interphase on the Transverse Tensile Strength of Composites with Initial Flaw and $E_f/E_m = 100$.

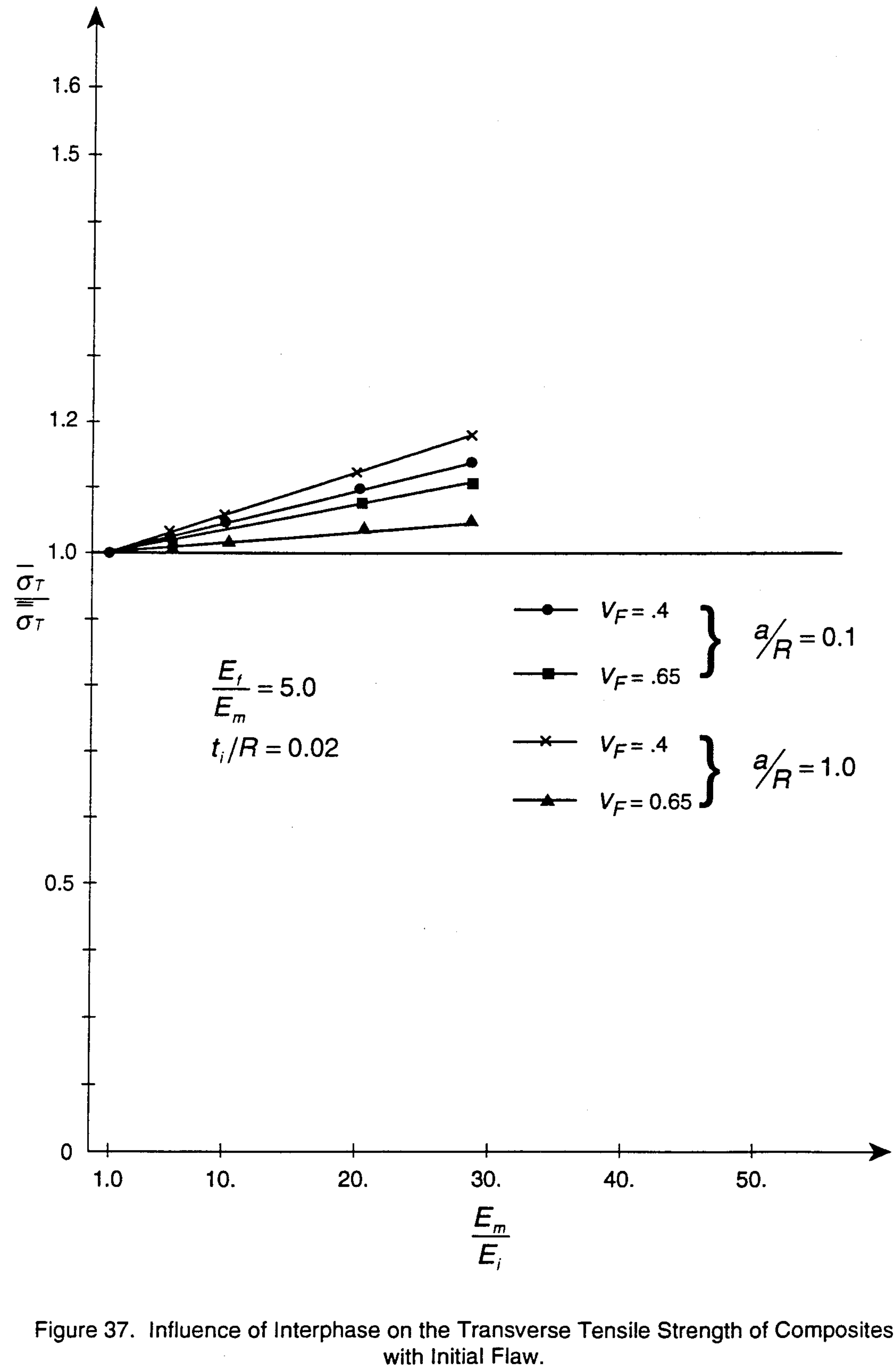


Figure 37. Influence of Interphase on the Transverse Tensile Strength of Composites with Initial Flaw.

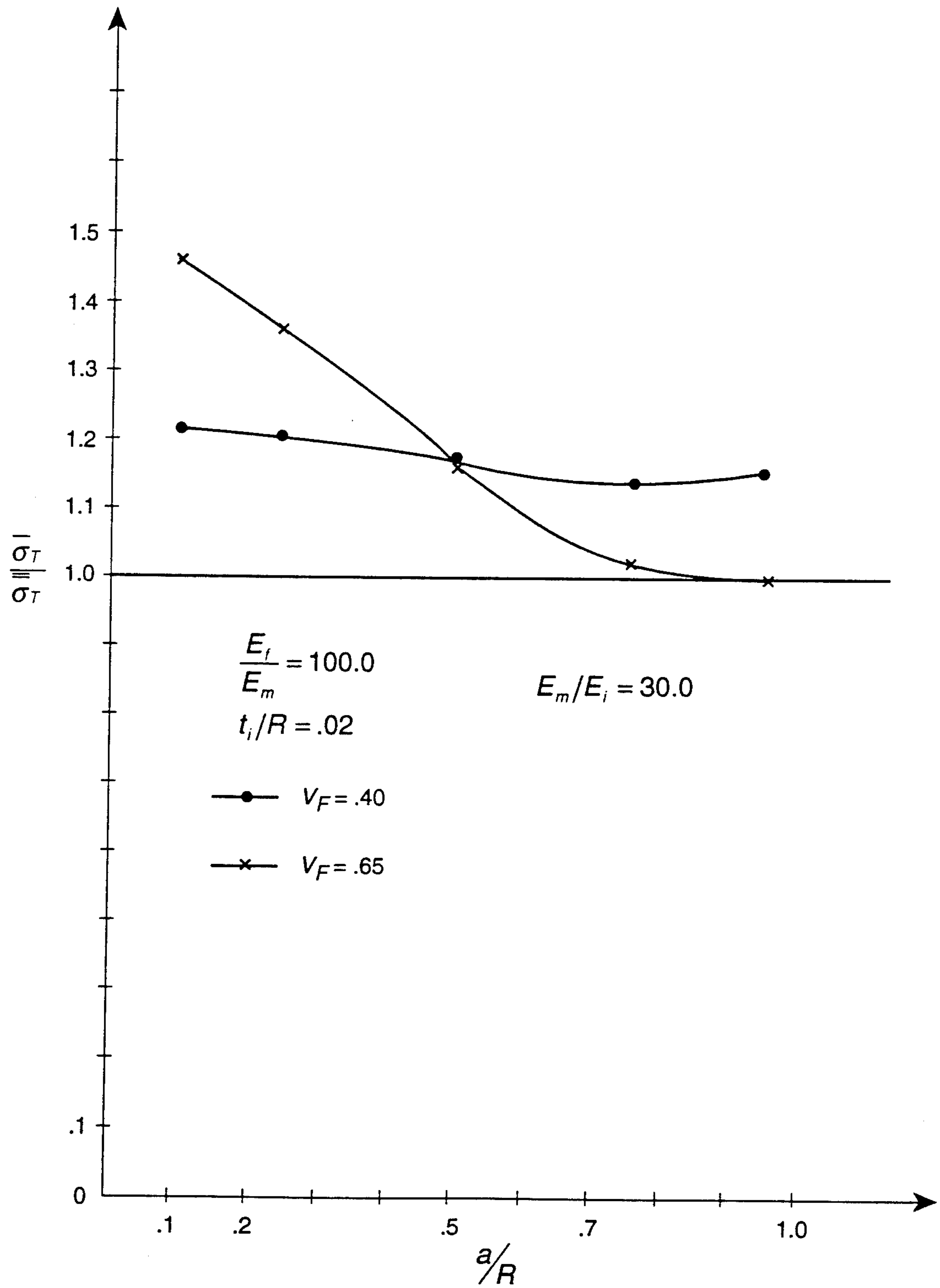


Figure 38. Influence of Interphase on the Transverse Tensile Strength of Composites with Various Initial Flaw Sizes.

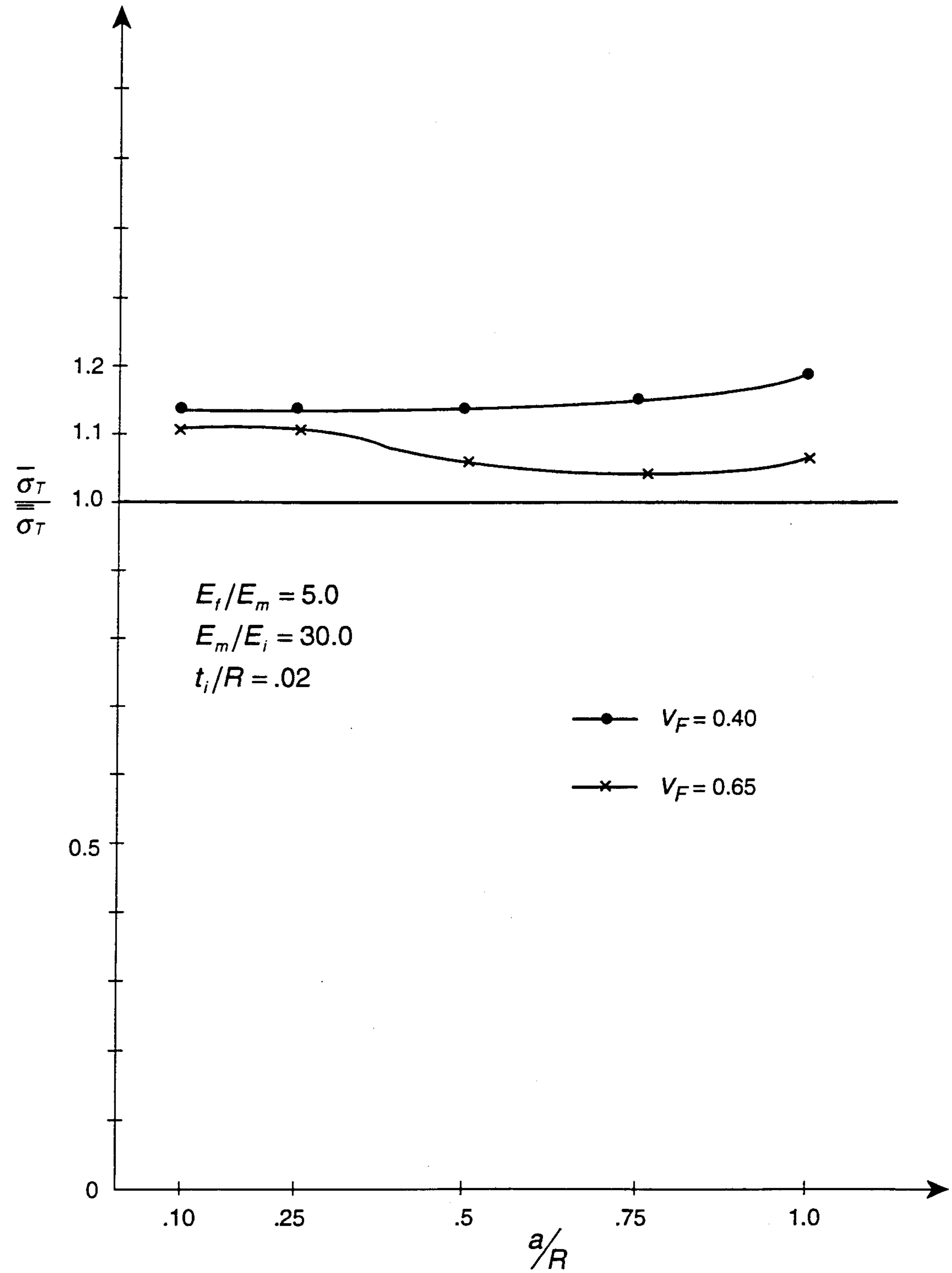


Figure 39. Influence of Interphase on the Transverse Tensile Strength of Composites with Various Initial Flaw Sizes.

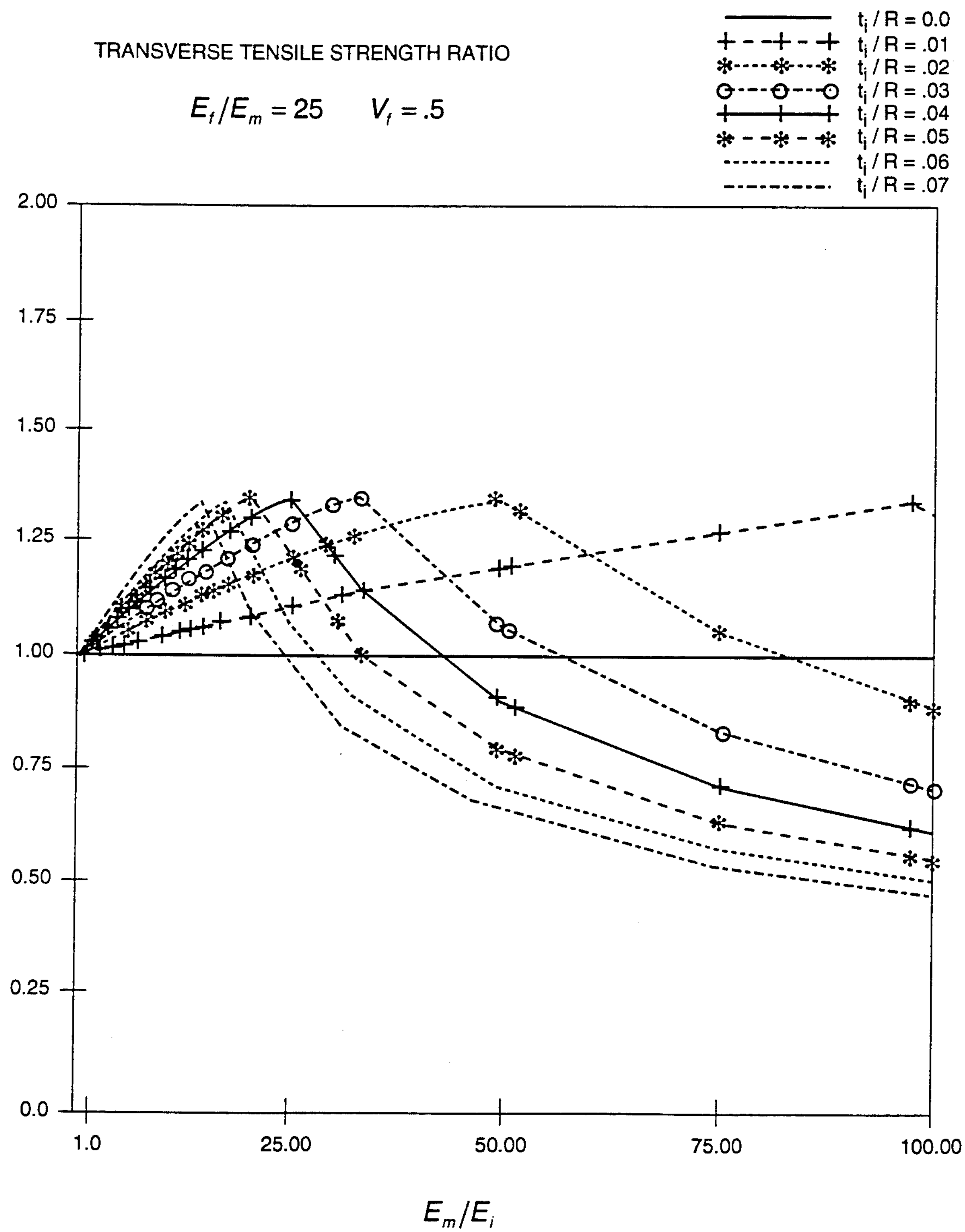


Figure 40. Design Charts of Interphase Properties and Thickness for Composites with $E_f / E_m = 25$ and $V_f = 0.5$.

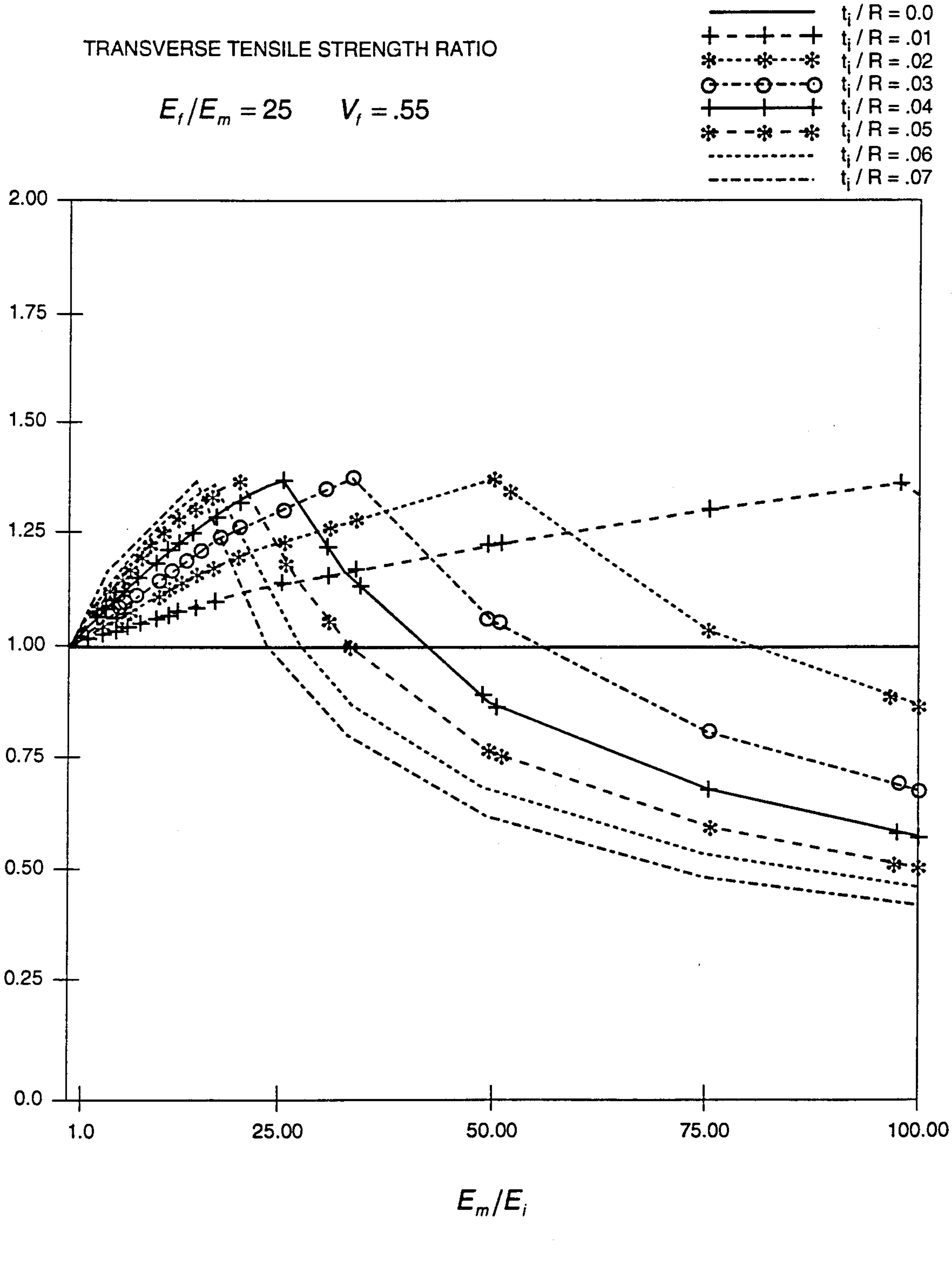


Figure 41. Design Charts of Interphase Properties and Thickness for Composites with $E_f / E_m = 25.0$ and $V_f = 0.55$.

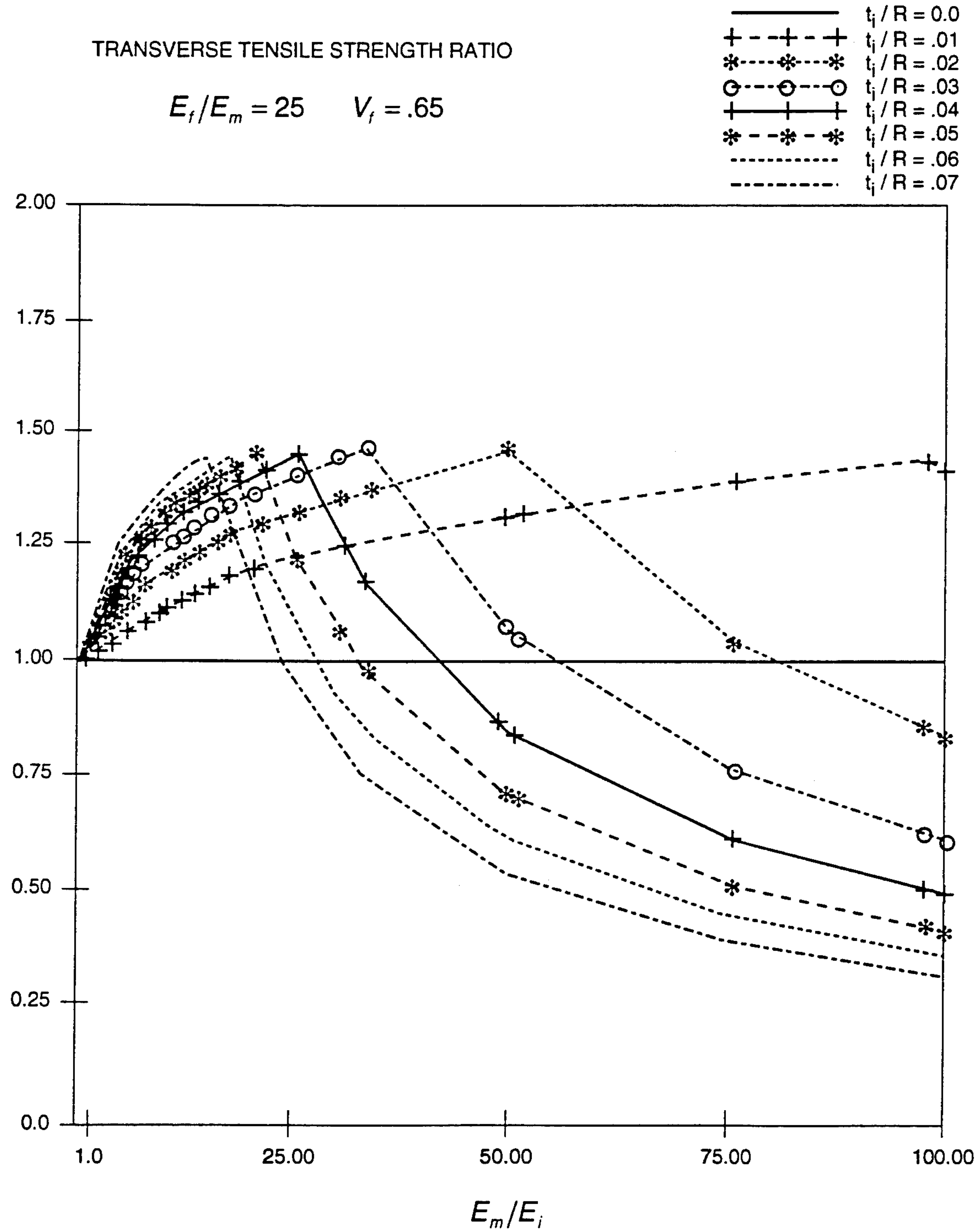


Figure 42. Design Charts of Interphase Properties and Thickness for Composites with $E_f / E_m = 25.0$ and $V_f = 0.65$.

APPENDIX A

APPENDIX A

TWO DIMENSIONAL FINITE ELEMENT MODEL FOR A UNIDIRECTIONAL COMPOSITE SUBJECT TO TRANSVERSE NORMAL LOADING

As shown in figure 4, two separate boundary-value problems must be solved in order to determine the local stresses of a unidirectional composite subject to transverse loading.

PROBLEM 1

$\tau_{xz} = 0$ along all four square boundaries

$u = 0$ along $x = 0$

$u = \bar{u} = 1.0$ along $x = l$

$\upsilon = 0$ along both $z = 0$ and $z = l$

PROBLEM 2

Same as problem 1 except:

$u = 0$ along $x = l$

$\upsilon = \bar{V} = 1.0$ along $z = l$

Let the stresses solution corresponding to problem 1 and 2 be $\sigma_{ij}^{(1)}$ and $\sigma_{ij}^{(2)}$, then from equation (3) and (4) of section 2, we have

$$\alpha \int_{-L}^{L} \sigma_x^{(1)} dz + \beta \int_{-L}^{L} \sigma_x^{(2)} dz = (2L)\sigma_T \quad \text{(A-1)}$$

$$\alpha \int_{-L}^{L} \sigma_z^{(1)} dx + \beta \int_{-L}^{L} \sigma_z^{(2)} dx = 0 \quad \text{(A-2)}$$

Let

$$\frac{1}{2L}\int_{-L}^{L}\sigma_x^{(1)}\,dz = \overline{\sigma}_x^{(1)} = \text{ average normal stress along } x = l \text{ for problem 1}$$

$$\frac{1}{2L}\int_{-L}^{L}\sigma_x^{(2)} = \overline{\sigma}_x^{(2)} = \text{ average normal stress along } x = l \text{ for problem 2}$$

$$\frac{1}{2L}\int_{-L}^{L}\sigma_z^{(1)}\,dx = \overline{\sigma}_z^{(1)} = \text{ average normal stress along } z = l \text{ for problem 1}$$

$$\frac{1}{2L}\int_{-L}^{L}\sigma_z^{(2)}\,dx = \overline{\sigma}_z^{(2)} = \text{ average normal stress along } z = l \text{ for problem 2}$$

Equation (A-1) and (A-2) can be rewritten as follows

$$\alpha\overline{\sigma}_x^{(1)} + \beta\overline{\sigma}_x^{(2)} = \sigma_T \tag{A-3}$$

$$\alpha\overline{\sigma}_z^{(1)} + \beta\overline{\sigma}_z^{(2)} = 0 \tag{A-4}$$

Solve for a and b from equations (A-3) and (A-4), we have

$$\alpha = \frac{\overline{\sigma}_z^{(2)}\sigma_T}{\left[\overline{\sigma}_x^{(1)}\overline{\sigma}_z^{(2)} - \overline{\sigma}_x^{(2)}\overline{\sigma}_z^{(1)}\right]}$$

$$\beta = \frac{-\overline{\sigma}_z^{(1)}\sigma_T}{\left[\overline{\sigma}_x^{(1)}\overline{\sigma}_z^{(2)} - \overline{\sigma}_x^{(2)}\overline{\sigma}_z^{(1)}\right]}$$

The final stress state can be expressed as

$$\sigma_{ij} = \alpha\sigma_{cj}^{(1)} + \beta\sigma_{ij}^{(2)} \tag{A-5}$$

APPENDIX B

APPENDIX B

TWO DIMENSIONAL THERMAL RESIDUAL STRESS ANALYSIS

Using the same concept as Appendix A, the two dimensional thermal stress analysis can be divided into solving three problems:

PROBLEM 1

Same boundary conditions as Problem 1 of Appendix A.

PROBLEM 2

Same boundary conditions as Problem 2 of Appendix A.

PROBLEM 3

$u = 0.0$ along $x = 0, l$

$\upsilon = 0.0$ along $z = 0, l$

$T = -\Delta T$

where $\Delta T =$ temperature drop from curing temperature to stress free temperature

Again, let the stress solutions corresponding to problem 1, 2, and 3 be $\sigma_{ij}^{(1)}$, $\sigma_{ij}^{(2)}$ and $\sigma_{ij}^{(3)}$ then according to equation (3) and (4) of section 2, we have

At $x = l$

$$\alpha\int_{-L}^{L}\sigma_x^{(1)}\,dz + \beta\int_{-L}^{L}\sigma_x^{(2)}\,dz + \int_{-L}^{L}\sigma_x^{(3)}\,dz = 0 \qquad \text{(B-1)}$$

At $z = l$

$$\alpha \int_{-L}^{L} \sigma_z^{(1)}\, dx + \beta \int_{-L}^{L} \sigma_z^{(2)}\, dx + \int_{-L}^{L} \sigma_z^{(3)}\, dx = 0.0 \tag{B-2}$$

Solving equation (B-1) and (B-2) for α and β, the final state of thermal residual stresses can be expressed as follows

$$\sigma_{ij} + \alpha\sigma_{ij}^{(1)} + \beta\sigma_{ij}^{(2)} + \sigma_{ij}^{(3)} \tag{B-3}$$

APPENDIX C

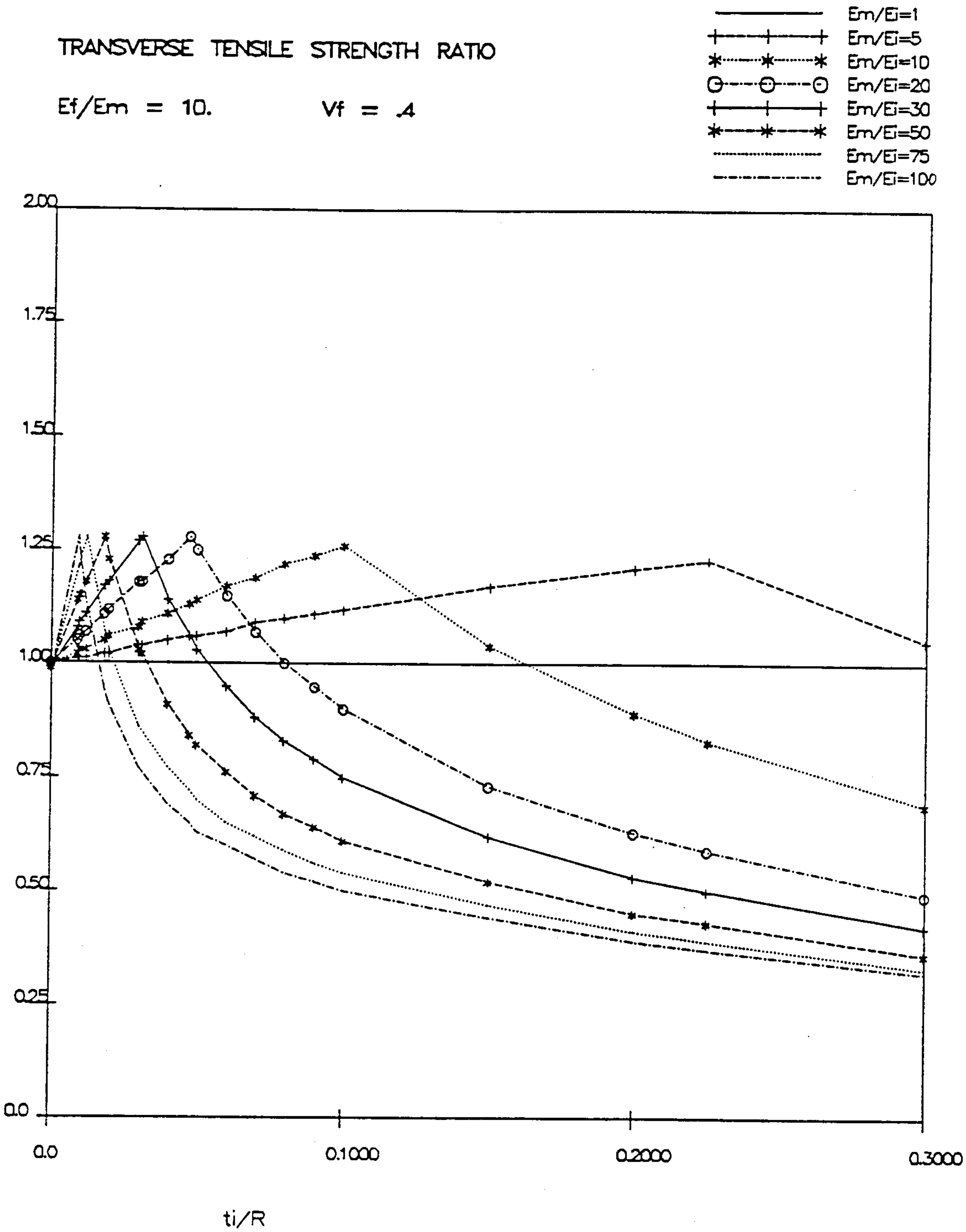
APPENDIX C

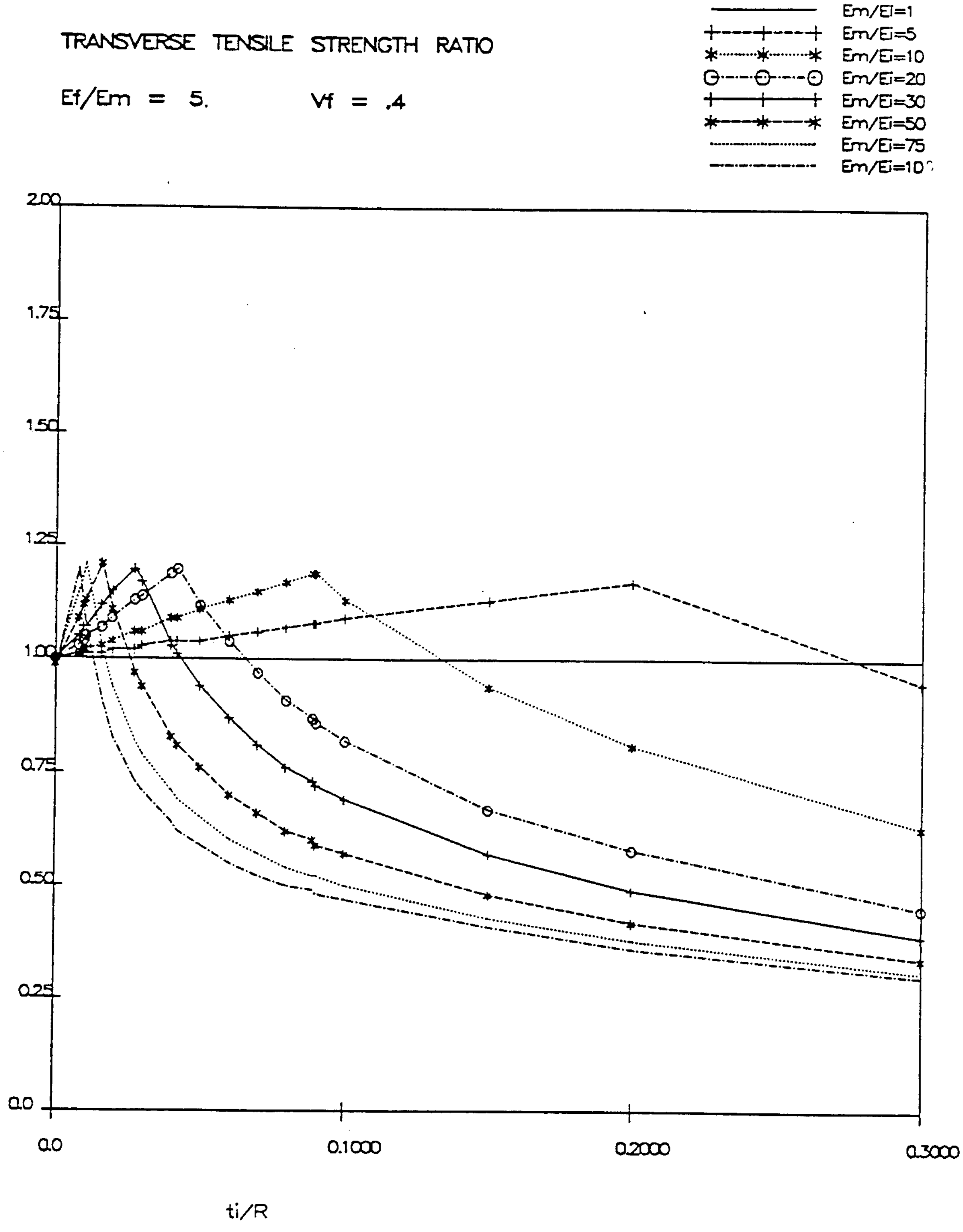
DESIGN CHARTS OF INTERPHASE PROPERTIES AND THICKNESS FOR IMPROVING THE TRANSVERSE TENSILE STRENGTH OF UNIDIRECTIONAL COMPOSITE MATERIALS

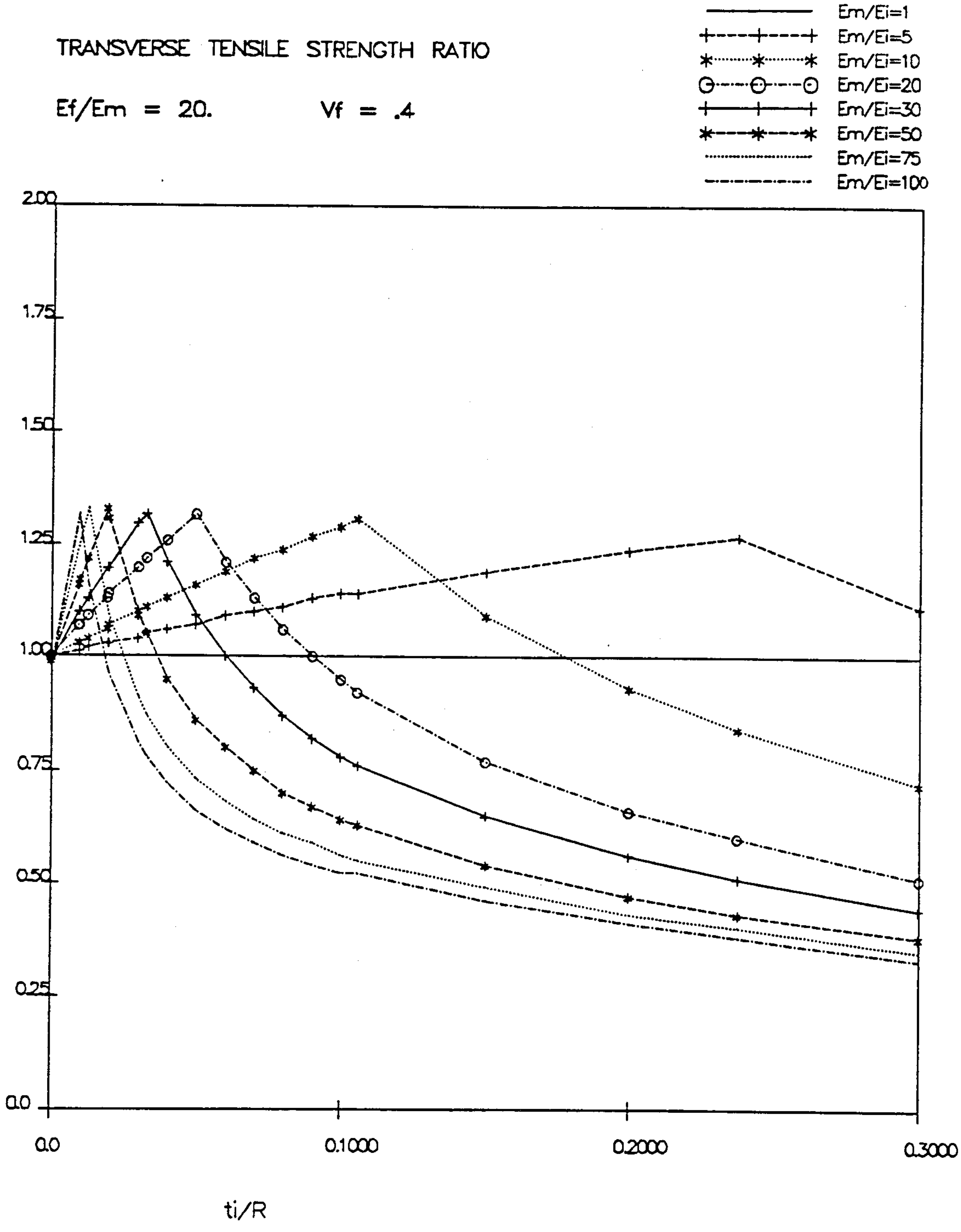
In this Appendix, design charts and corresponding design tables are listed from page C-1 to page C-181. The contents are summarized in Table C-1. As can be seen from this table, fiber volume fraction is ranged from 0.4 to .7. Two kinds of charts are provided. One is transverse tensile strength ratio (i.e., TTSR) versus (E_m/E_i) , the other is transverse tensile tensile strength versus (t_i/R). Both charts can be used by design engineers for their own convenience. Tables which produce design charts are also provided for reference.

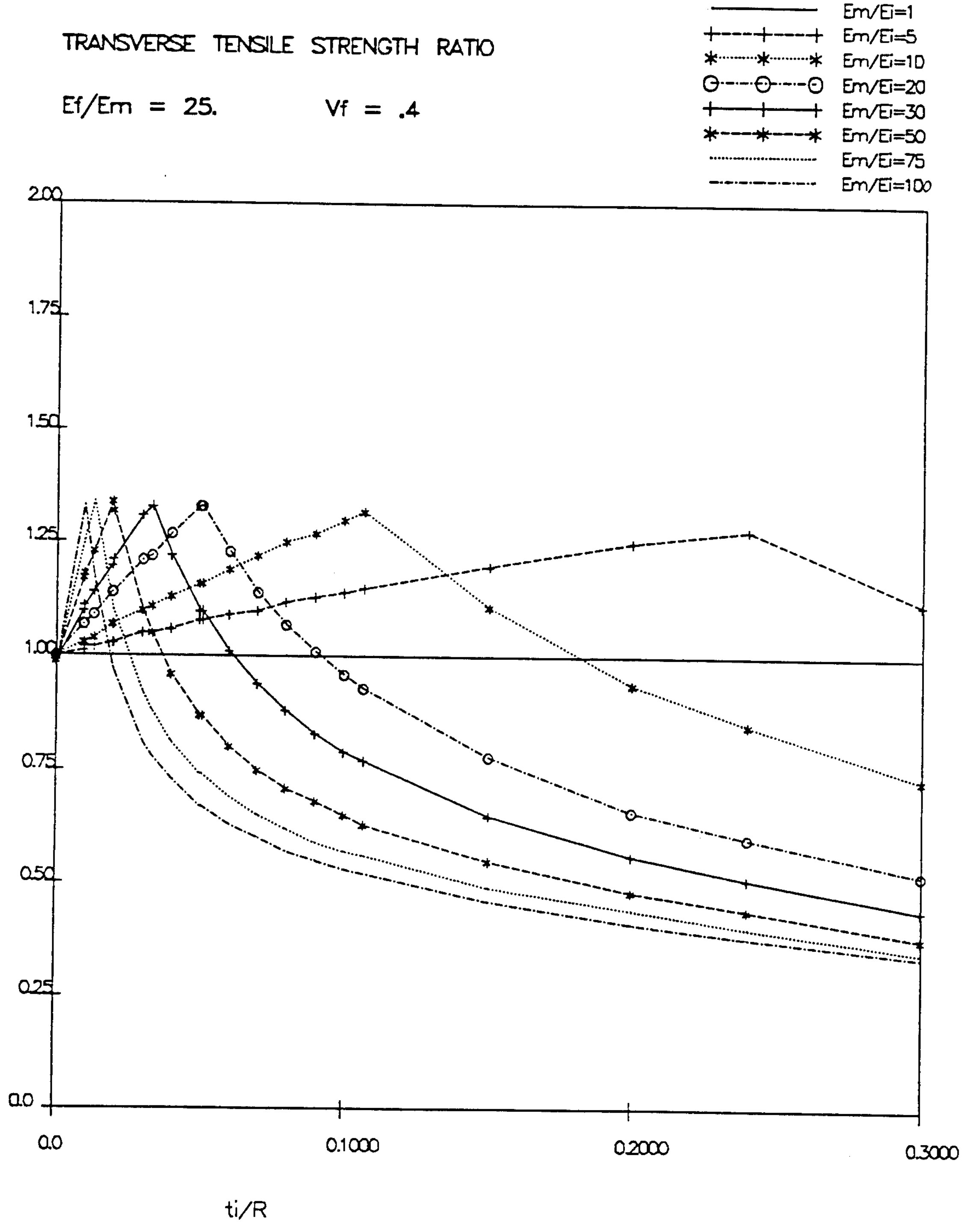
TABLE C-1. TABLE OF CONTENTS OF INTERPHASE DESIGN CHARTS AND DESIGN TABLES

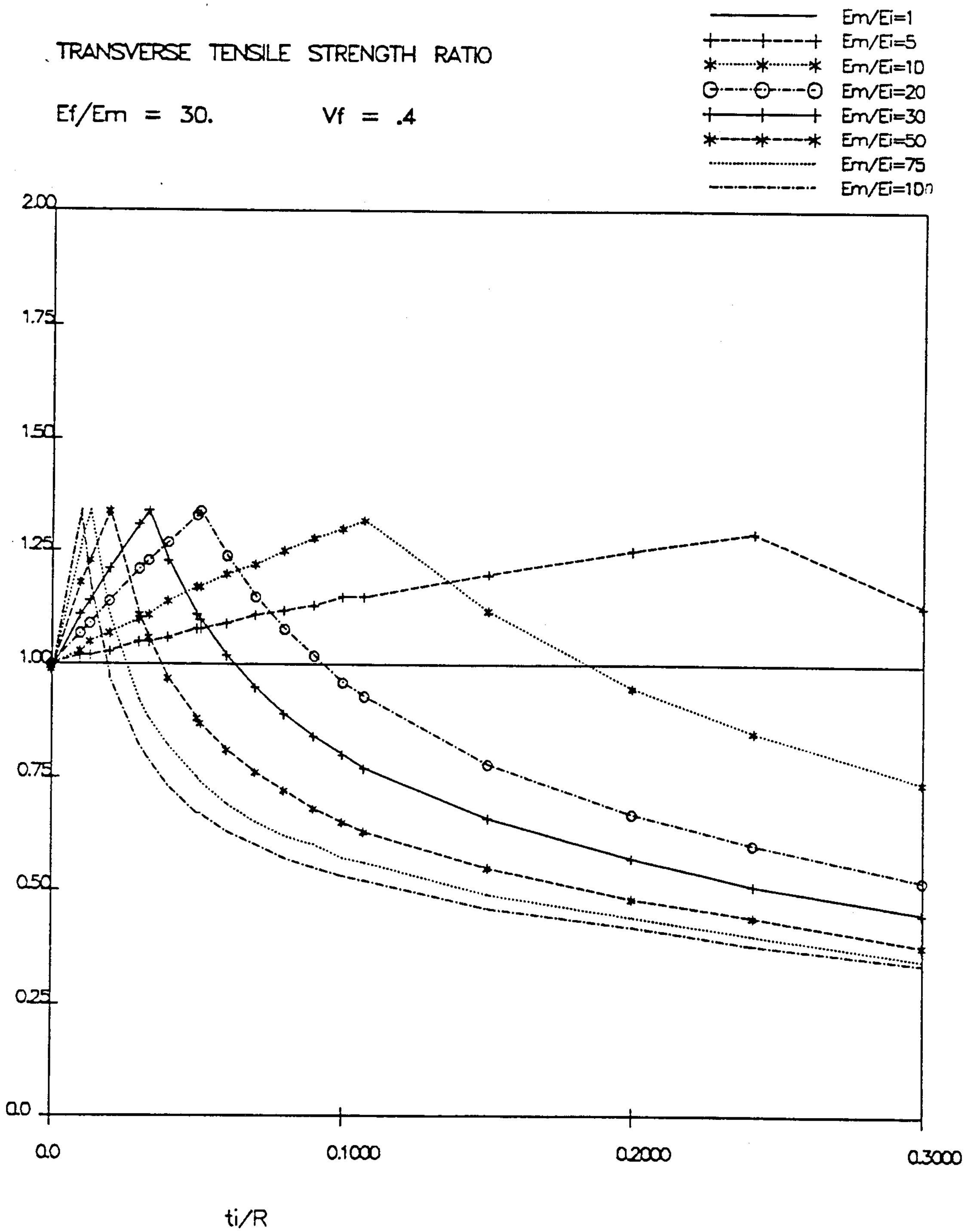
PAGE		V_F	CHART		TABLE	
From	To		TTSR vs (E_m / E_i)	TTSR vs (t_i / R)	TTSR vs (E_m / E_i)	TTSR vs (t_i / R)
C1	C7	.40	—	✓	—	—
C8	C14		—	—	—	✓
C15	C28	.50	✓	—	—	—
C29	C35		—	—	✓	—
C36	C42		—	✓	—	—
C43	C49		—	—	—	✓
C50	C63	.55	✓	—	—	—
C64	C70		—	—	✓	—
C71	C77		—	✓	—	—
C78	C84		—	—	—	✓
C85	C98	.60	✓	—	—	—
C99	C105		—	—	✓	—
C106	C112		—	✓	—	—
C113	C119		—	—	—	✓
C120	C133	.65	✓	—	—	—
C134	C139		—	—	✓	—
C140	C146		—	✓	—	—
C147	C153		—	—	—	✓
C154	C160	.70	✓	—	—	—
C161	C167		—	—	✓	—
C168	C174		—	✓	—	—
C175	C181		—	—	—	✓

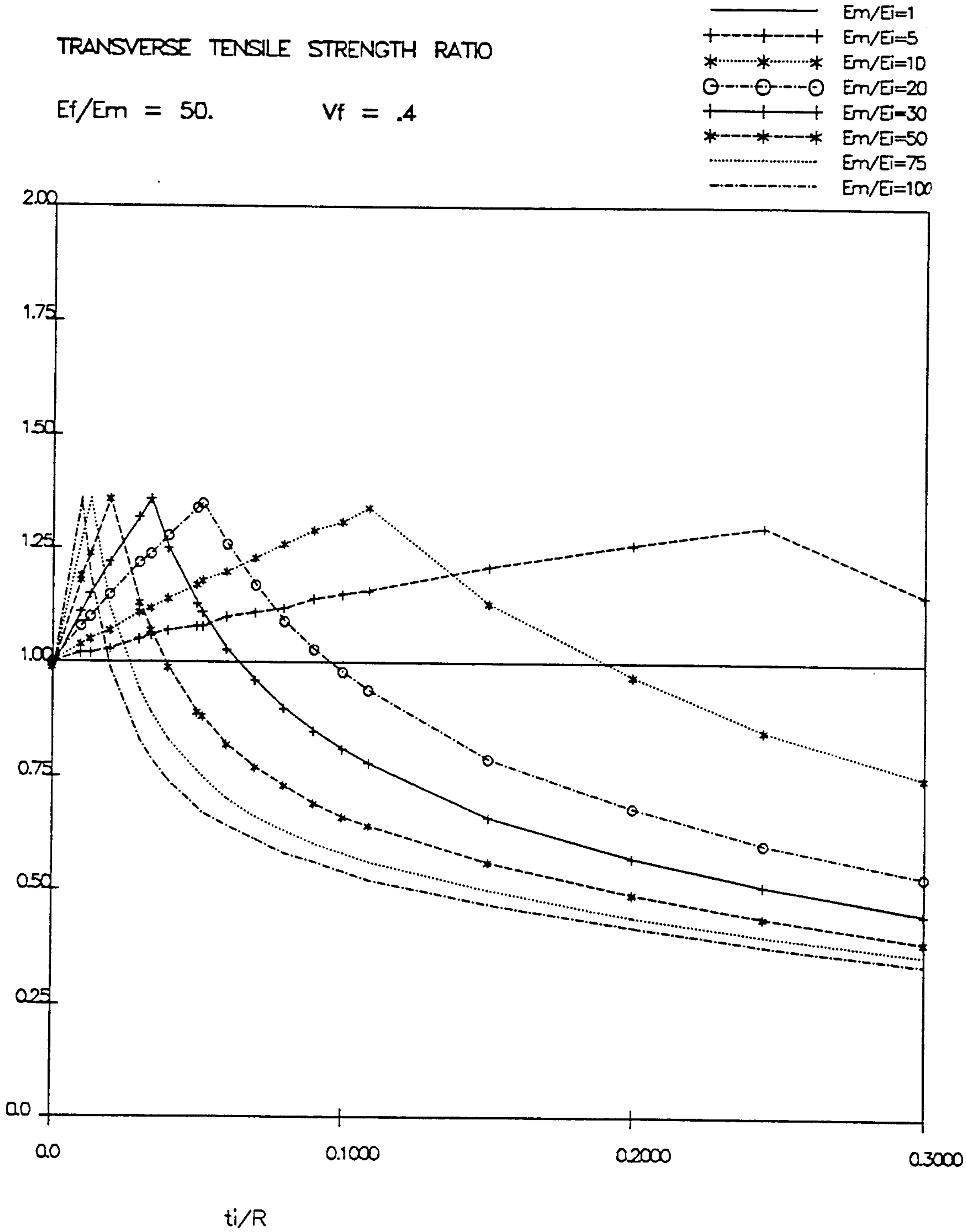

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10.
Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R

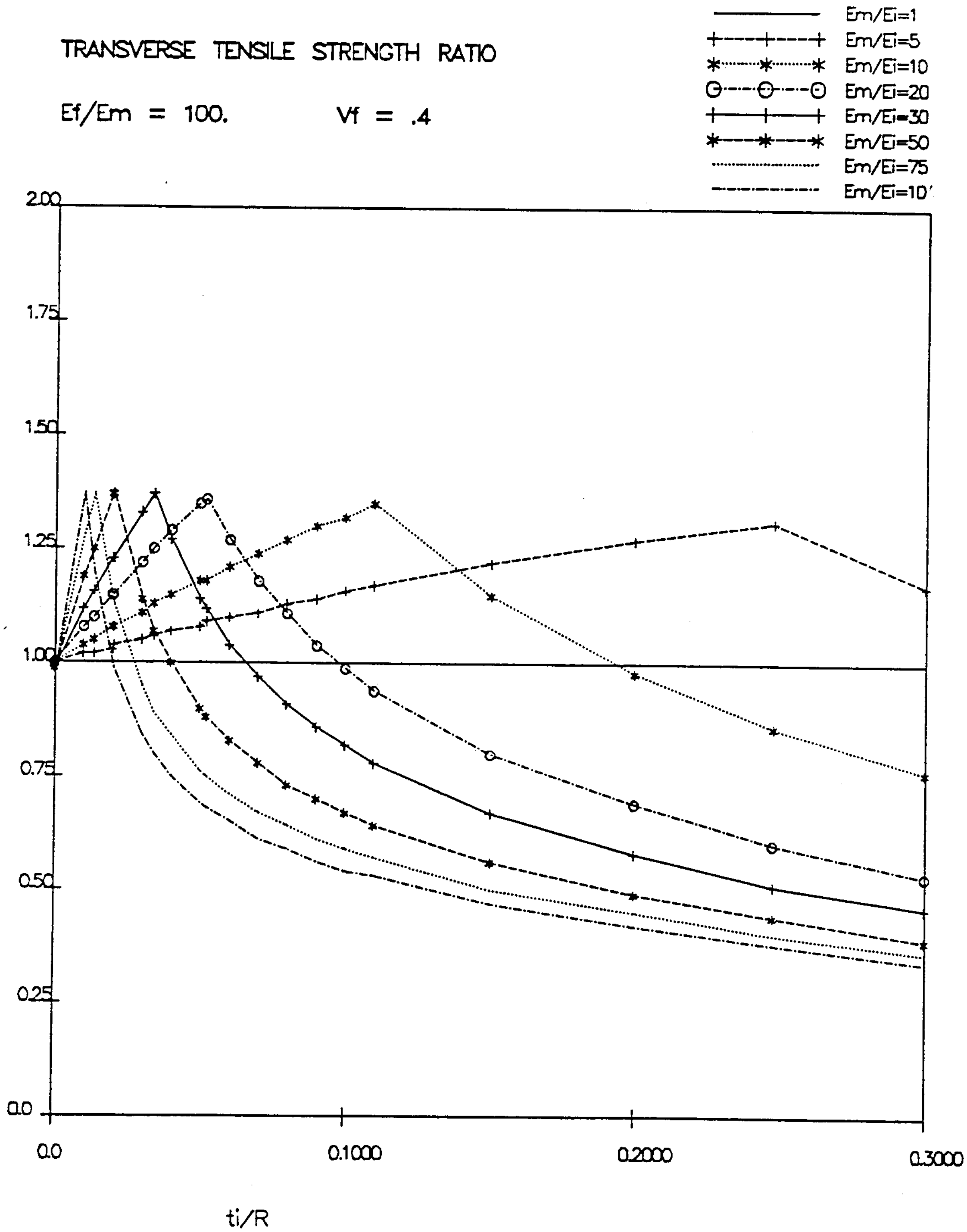

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5. Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=10
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20.
Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25.
Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30.
Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50. Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100.
Vf = .4
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=10'
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0
0.1000
0.2000
0.3000
ti/R

tratout Fri Dec 18 14:02:32 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.40 max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.98
0.008	1.00	1.01	1.01	1.03	1.05	1.09	1.15	1.20
0.010	1.00	1.01	1.02	1.04	1.07	1.12	1.19	1.11
0.011	1.00	1.01	1.02	1.05	1.07	1.13	1.21	1.07
0.016	1.00	1.01	1.03	1.07	1.12	1.21	1.02	0.91
0.020	1.00	1.02	1.04	1.09	1.15	1.11	0.94	0.83
0.028	1.00	1.02	1.06	1.13	1.20	0.97	0.82	0.73
0.030	1.00	1.03	1.06	1.14	1.17	0.94	0.79	0.71
0.040	1.00	1.04	1.09	1.19	1.03	0.83	0.71	0.64
0.042	1.00	1.04	1.09	1.20	1.01	0.81	0.69	0.62
0.050	1.00	1.04	1.11	1.12	0.94	0.76	0.65	0.59
0.060	1.00	1.05	1.13	1.04	0.87	0.70	0.60	0.55
0.070	1.00	1.06	1.15	0.97	0.81	0.66	0.57	0.52
0.080	1.00	1.07	1.17	0.91	0.76	0.62	0.54	0.50
0.089	1.00	1.08	1.19	0.87	0.73	0.60	0.52	0.49
0.090	1.00	1.08	1.19	0.86	0.72	0.59	0.52	0.48
0.100	1.00	1.09	1.13	0.82	0.69	0.57	0.50	0.47
0.150	1.00	1.13	0.94	0.67	0.57	0.48	0.43	0.41
0.200	1.00	1.17	0.81	0.58	0.49	0.42	0.38	0.36
0.200	1.00	1.17	0.81	0.58	0.49	0.42	0.38	0.36
0.300	1.00	0.95	0.63	0.45	0.39	0.34	0.31	0.30
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout Fri Dec 18 14:02:40 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.40 max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.009	1.00	1.01	1.02	1.05	1.08	1.14	1.21	1.28
0.010	1.00	1.01	1.03	1.06	1.09	1.15	1.23	1.23
0.012	1.00	1.01	1.03	1.07	1.11	1.18	1.28	1.13
0.018	1.00	1.02	1.05	1.11	1.17	1.28	1.07	0.94
0.020	1.00	1.02	1.06	1.12	1.18	1.23	1.03	0.91
0.030	1.00	1.04	1.08	1.18	1.27	1.03	0.86	0.77
0.031	1.00	1.04	1.09	1.18	1.28	1.02	0.85	0.76
0.040	1.00	1.05	1.11	1.23	1.14	0.91	0.77	0.69
0.047	1.00	1.06	1.13	1.28	1.06	0.84	0.72	0.65
0.050	1.00	1.06	1.14	1.25	1.03	0.82	0.70	0.63
0.060	1.00	1.07	1.17	1.15	0.95	0.76	0.65	0.60
0.070	1.00	1.09	1.19	1.07	0.88	0.71	0.62	0.57
0.080	1.00	1.10	1.22	1.00	0.83	0.67	0.59	0.54
0.090	1.00	1.11	1.24	0.95	0.79	0.64	0.56	0.52
0.100	1.00	1.12	1.26	0.90	0.75	0.61	0.54	0.50
0.100	1.00	1.12	1.26	0.90	0.75	0.61	0.54	0.50
0.150	1.00	1.17	1.04	0.73	0.62	0.52	0.47	0.44
0.200	1.00	1.21	0.89	0.63	0.53	0.45	0.41	0.39
0.225	1.00	1.23	0.83	0.59	0.50	0.43	0.39	0.37
0.300	1.00	1.05	0.69	0.49	0.42	0.36	0.33	0.32
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout   Fri Dec 18 14:02:53 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0   Vf = 0.40   max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.010	1.00	1.01	1.03	1.07	1.10	1.16	1.25	1.32
0.010	1.00	1.01	1.03	1.07	1.10	1.17	1.26	1.30
0.013	1.00	1.02	1.04	1.09	1.13	1.22	1.33	1.16
0.019	1.00	1.03	1.06	1.13	1.20	1.33	1.10	0.97
0.020	1.00	1.03	1.07	1.14	1.20	1.31	1.09	0.96
0.030	1.00	1.04	1.10	1.20	1.30	1.09	0.91	0.81
0.033	1.00	1.05	1.11	1.22	1.32	1.05	0.87	0.78
0.040	1.00	1.06	1.13	1.26	1.21	0.95	0.80	0.72
0.050	1.00	1.07	1.16	1.32	1.09	0.86	0.73	0.66
0.050	1.00	1.07	1.16	1.32	1.09	0.86	0.73	0.66
0.060	1.00	1.09	1.19	1.21	1.00	0.80	0.68	0.62
0.070	1.00	1.10	1.22	1.13	0.93	0.75	0.64	0.59
0.080	1.00	1.11	1.24	1.06	0.87	0.70	0.61	0.56
0.090	1.00	1.13	1.27	1.00	0.82	0.67	0.59	0.54
0.100	1.00	1.14	1.29	0.95	0.78	0.64	0.56	0.52
0.106	1.00	1.14	1.31	0.92	0.76	0.63	0.55	0.52
0.150	1.00	1.19	1.09	0.77	0.65	0.54	0.49	0.46
0.200	1.00	1.24	0.93	0.66	0.56	0.47	0.43	0.41
0.237	1.00	1.27	0.84	0.60	0.51	0.43	0.40	0.38
0.300	1.00	1.11	0.72	0.51	0.44	0.38	0.35	0.33
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout Fri Dec 18 14:02:58 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.40 max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.010	1.00	1.01	1.03	1.07	1.10	1.17	1.25	1.33
0.010	1.00	1.02	1.03	1.07	1.11	1.18	1.26	1.32
0.013	1.00	1.02	1.04	1.09	1.14	1.23	1.34	1.17
0.020	1.00	1.03	1.07	1.14	1.20	1.34	1.11	0.98
0.020	1.00	1.03	1.07	1.14	1.21	1.32	1.10	0.97
0.030	1.00	1.05	1.10	1.21	1.31	1.10	0.92	0.81
0.033	1.00	1.05	1.11	1.22	1.33	1.05	0.88	0.78
0.040	1.00	1.06	1.13	1.27	1.22	0.96	0.81	0.73
0.050	1.00	1.08	1.16	1.33	1.10	0.87	0.74	0.67
0.051	1.00	1.08	1.16	1.33	1.10	0.87	0.74	0.67
0.060	1.00	1.09	1.19	1.23	1.01	0.80	0.69	0.63
0.070	1.00	1.10	1.22	1.14	0.94	0.75	0.65	0.60
0.080	1.00	1.12	1.25	1.07	0.88	0.71	0.62	0.57
0.090	1.00	1.13	1.27	1.01	0.83	0.68	0.59	0.55
0.100	1.00	1.14	1.30	0.96	0.79	0.65	0.57	0.53
0.107	1.00	1.15	1.32	0.93	0.77	0.63	0.56	0.52
0.150	1.00	1.20	1.11	0.78	0.65	0.55	0.49	0.46
0.200	1.00	1.25	0.94	0.66	0.56	0.48	0.44	0.41
0.240	1.00	1.28	0.85	0.60	0.51	0.44	0.40	0.38
0.300	1.00	1.12	0.73	0.52	0.44	0.38	0.35	0.34
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 14:03:05 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.40 max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.010	1.00	1.02	1.03	1.07	1.11	1.18	1.26	1.34
0.010	1.00	1.02	1.03	1.07	1.11	1.18	1.27	1.33
0.013	1.00	1.02	1.05	1.09	1.14	1.23	1.34	1.18
0.020	1.00	1.03	1.07	1.14	1.21	1.34	1.11	0.98
0.020	1.00	1.03	1.07	1.14	1.21	1.34	1.11	0.97
0.030	1.00	1.05	1.10	1.21	1.31	1.11	0.92	0.82
0.033	1.00	1.05	1.11	1.23	1.34	1.06	0.88	0.79
0.040	1.00	1.06	1.14	1.27	1.23	0.97	0.82	0.73
0.050	1.00	1.08	1.17	1.33	1.11	0.88	0.75	0.67
0.051	1.00	1.08	1.17	1.34	1.10	0.87	0.74	0.67
0.060	1.00	1.09	1.20	1.24	1.02	0.81	0.69	0.63
0.070	1.00	1.11	1.22	1.15	0.95	0.76	0.65	0.60
0.080	1.00	1.12	1.25	1.08	0.89	0.72	0.62	0.57
0.090	1.00	1.13	1.28	1.02	0.84	0.68	0.60	0.55
0.100	1.00	1.15	1.30	0.96	0.80	0.65	0.57	0.53
0.107	1.00	1.15	1.32	0.93	0.77	0.63	0.56	0.52
0.150	1.00	1.20	1.12	0.78	0.66	0.55	0.49	0.46
0.200	1.00	1.25	0.95	0.67	0.57	0.48	0.44	0.42
0.242	1.00	1.29	0.85	0.60	0.51	0.44	0.40	0.38
0.300	1.00	1.13	0.74	0.52	0.45	0.38	0.35	0.34
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout   Fri Dec 18 14:03:09 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0   Vf = 0.40   max ti/R = 0.401

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.010	1.00	1.02	1.04	1.08	1.11	1.18	1.27	1.36
0.010	1.00	1.02	1.04	1.08	1.11	1.19	1.27	1.35
0.013	1.00	1.02	1.05	1.10	1.15	1.24	1.36	1.19
0.020	1.00	1.03	1.07	1.15	1.22	1.36	1.12	0.99
0.020	1.00	1.03	1.07	1.15	1.22	1.36	1.12	0.99
0.030	1.00	1.05	1.11	1.22	1.32	1.13	0.94	0.83
0.034	1.00	1.06	1.12	1.24	1.36	1.07	0.89	0.79
0.040	1.00	1.07	1.14	1.28	1.25	0.99	0.83	0.74
0.050	1.00	1.08	1.17	1.34	1.13	0.89	0.76	0.68
0.052	1.00	1.08	1.18	1.35	1.11	0.88	0.75	0.67
0.060	1.00	1.10	1.20	1.26	1.03	0.82	0.70	0.64
0.070	1.00	1.11	1.23	1.17	0.96	0.77	0.66	0.61
0.080	1.00	1.12	1.26	1.09	0.90	0.73	0.63	0.58
0.090	1.00	1.14	1.29	1.03	0.85	0.69	0.60	0.56
0.100	1.00	1.15	1.31	0.98	0.81	0.66	0.58	0.54
0.109	1.00	1.16	1.34	0.94	0.78	0.64	0.56	0.52
0.150	1.00	1.21	1.13	0.79	0.66	0.56	0.50	0.47
0.200	1.00	1.26	0.97	0.68	0.57	0.49	0.44	0.42
0.245	1.00	1.30	0.85	0.60	0.51	0.44	0.40	0.38
0.300	1.00	1.15	0.75	0.53	0.45	0.39	0.36	0.34
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Fri Dec 18 14:03:13 1992 1

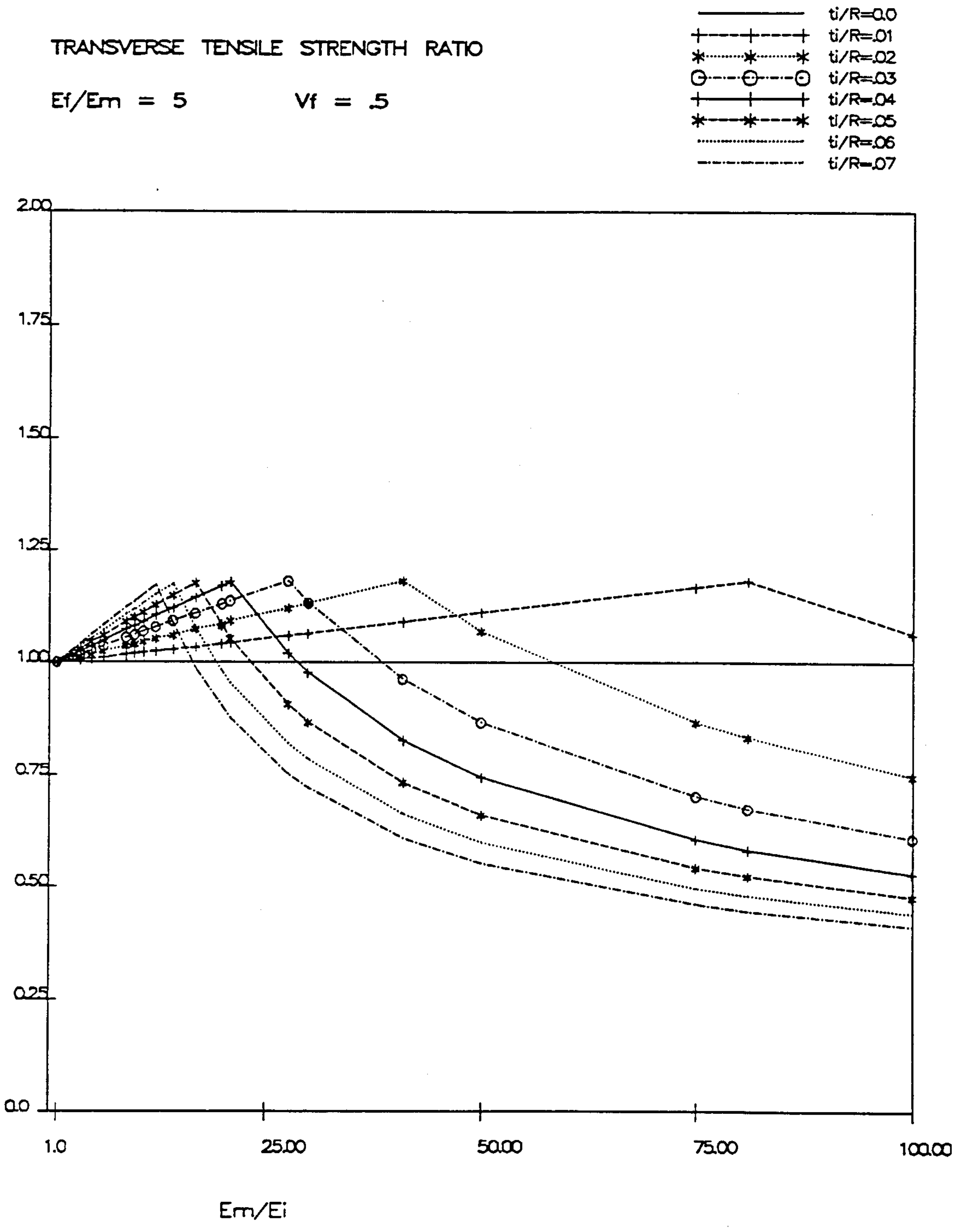
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

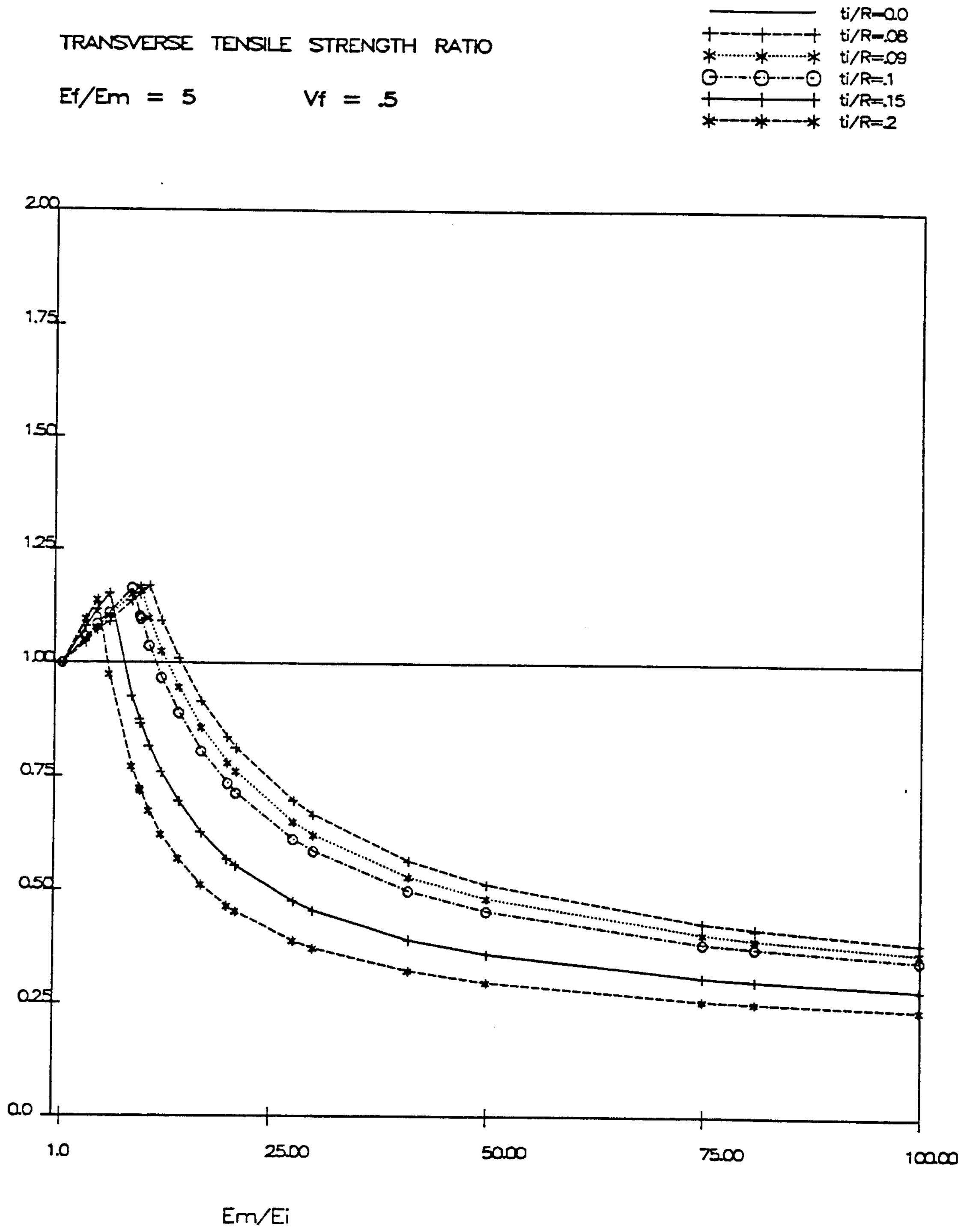
Ef / Em =100.0 Vf = 0.40 max ti/R = 0.401

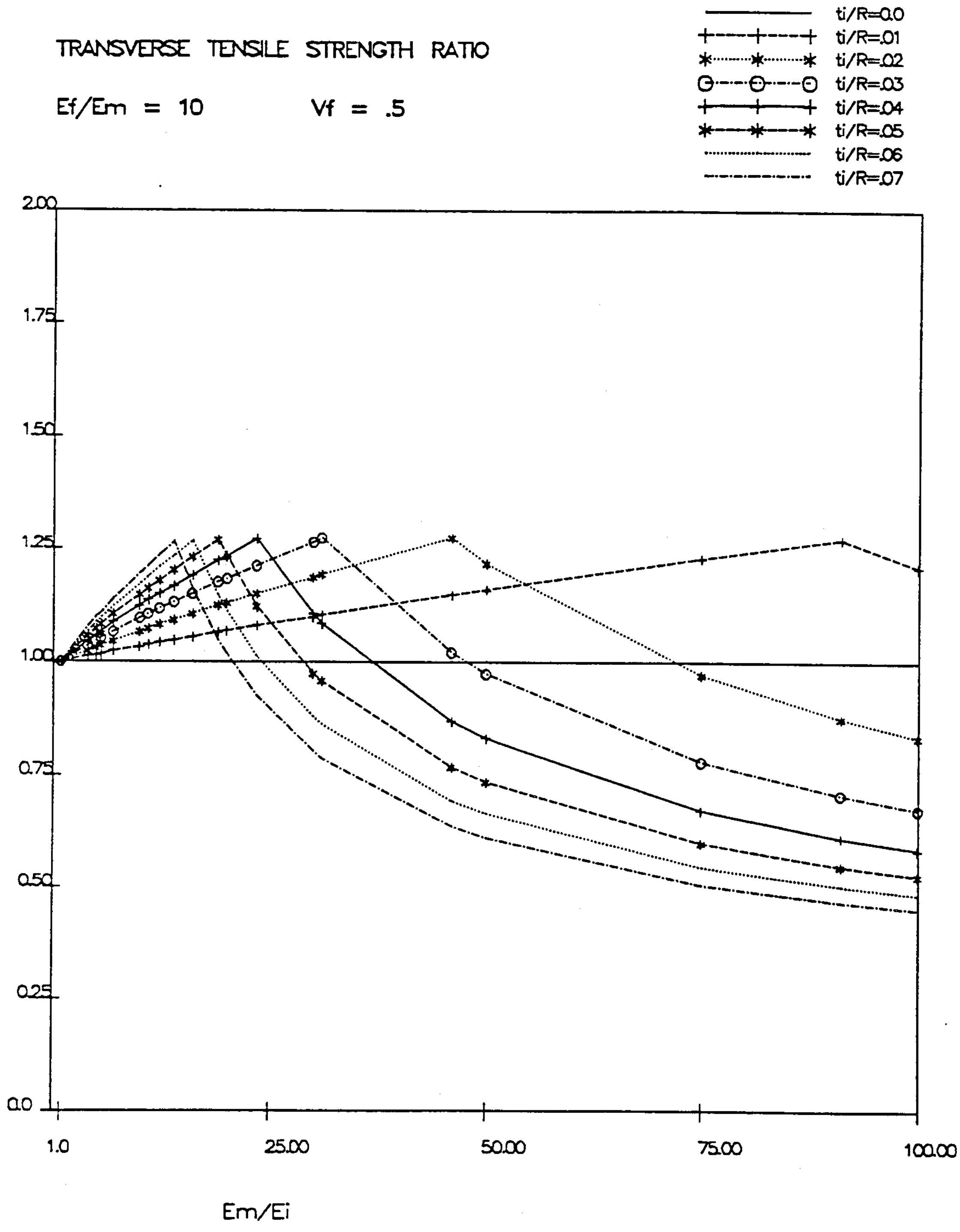
TRANSVERSE TENSILE STRENGTH RATIO

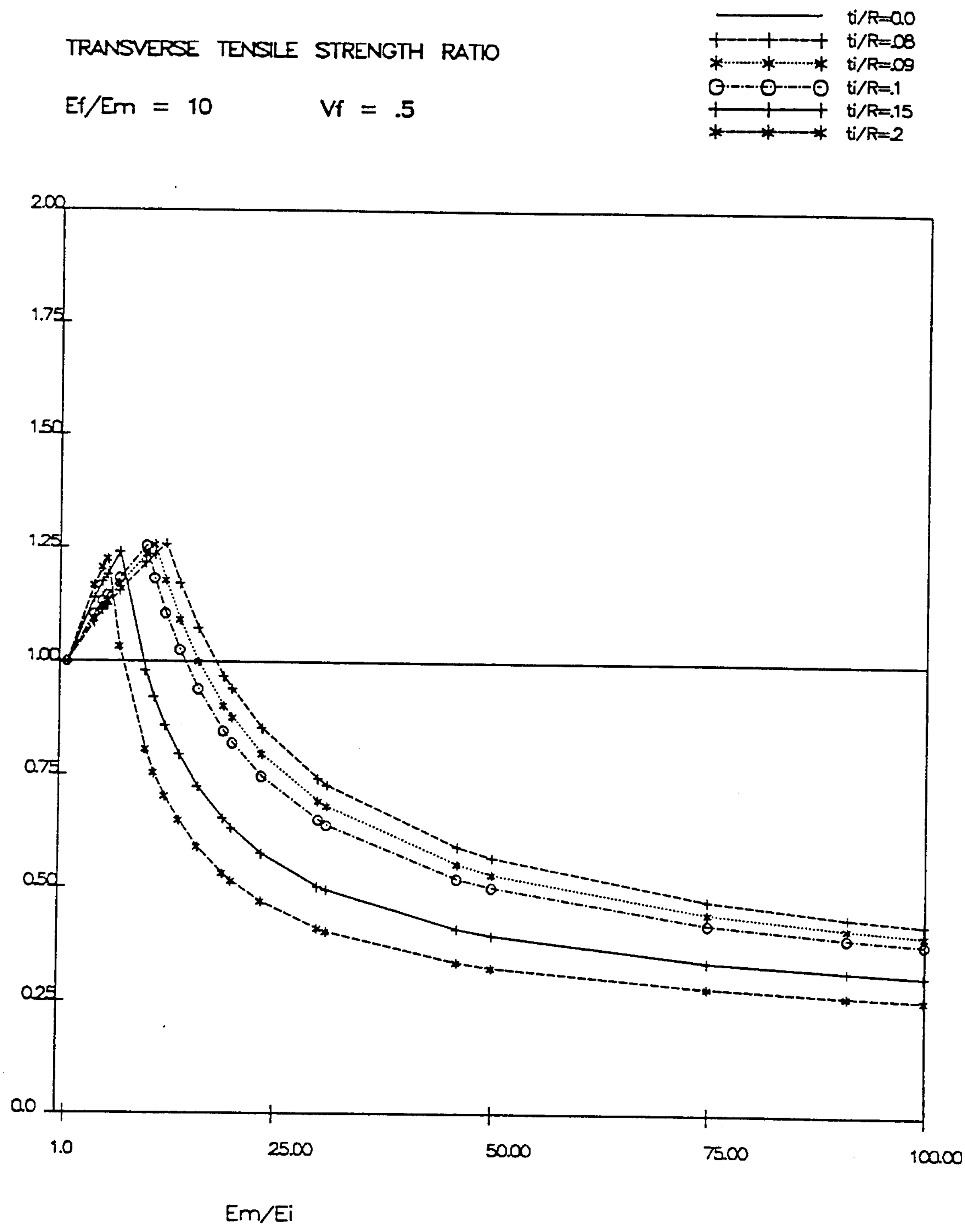
	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.010	1.00	1.02	1.04	1.08	1.12	1.19	1.28	1.37
0.010	1.00	1.02	1.04	1.08	1.12	1.19	1.28	1.37
0.013	1.00	1.02	1.05	1.10	1.16	1.25	1.37	1.20
0.020	1.00	1.03	1.08	1.15	1.23	1.37	1.14	1.00
0.020	1.00	1.04	1.08	1.15	1.23	1.37	1.13	0.99
0.030	1.00	1.05	1.11	1.22	1.33	1.14	0.95	0.84
0.034	1.00	1.06	1.13	1.25	1.37	1.07	0.89	0.80
0.040	1.00	1.07	1.15	1.29	1.27	1.00	0.84	0.75
0.050	1.00	1.08	1.18	1.35	1.14	0.90	0.76	0.69
0.052	1.00	1.09	1.18	1.36	1.12	0.88	0.75	0.68
0.060	1.00	1.10	1.21	1.27	1.04	0.83	0.71	0.65
0.070	1.00	1.11	1.24	1.18	0.97	0.78	0.67	0.61
0.080	1.00	1.13	1.27	1.11	0.91	0.73	0.64	0.59
0.090	1.00	1.14	1.30	1.04	0.86	0.70	0.61	0.56
0.100	1.00	1.16	1.32	0.99	0.82	0.67	0.59	0.54
0.110	1.00	1.17	1.35	0.94	0.78	0.64	0.57	0.53
0.150	1.00	1.22	1.15	0.80	0.67	0.56	0.50	0.47
0.200	1.00	1.27	0.98	0.69	0.58	0.49	0.45	0.42
0.248	1.00	1.31	0.86	0.60	0.51	0.44	0.40	0.38
0.300	1.00	1.17	0.76	0.53	0.46	0.39	0.36	0.34
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010



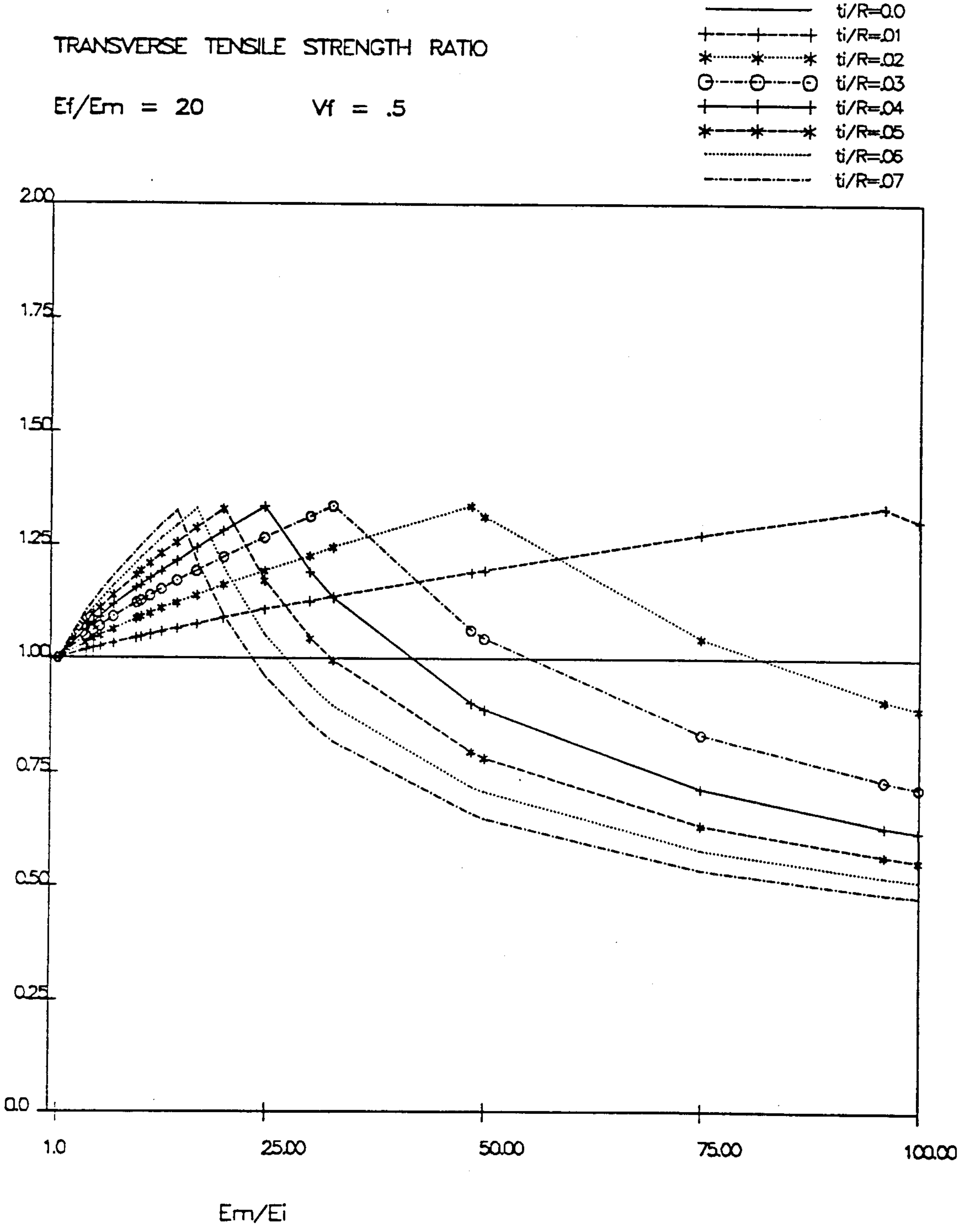
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

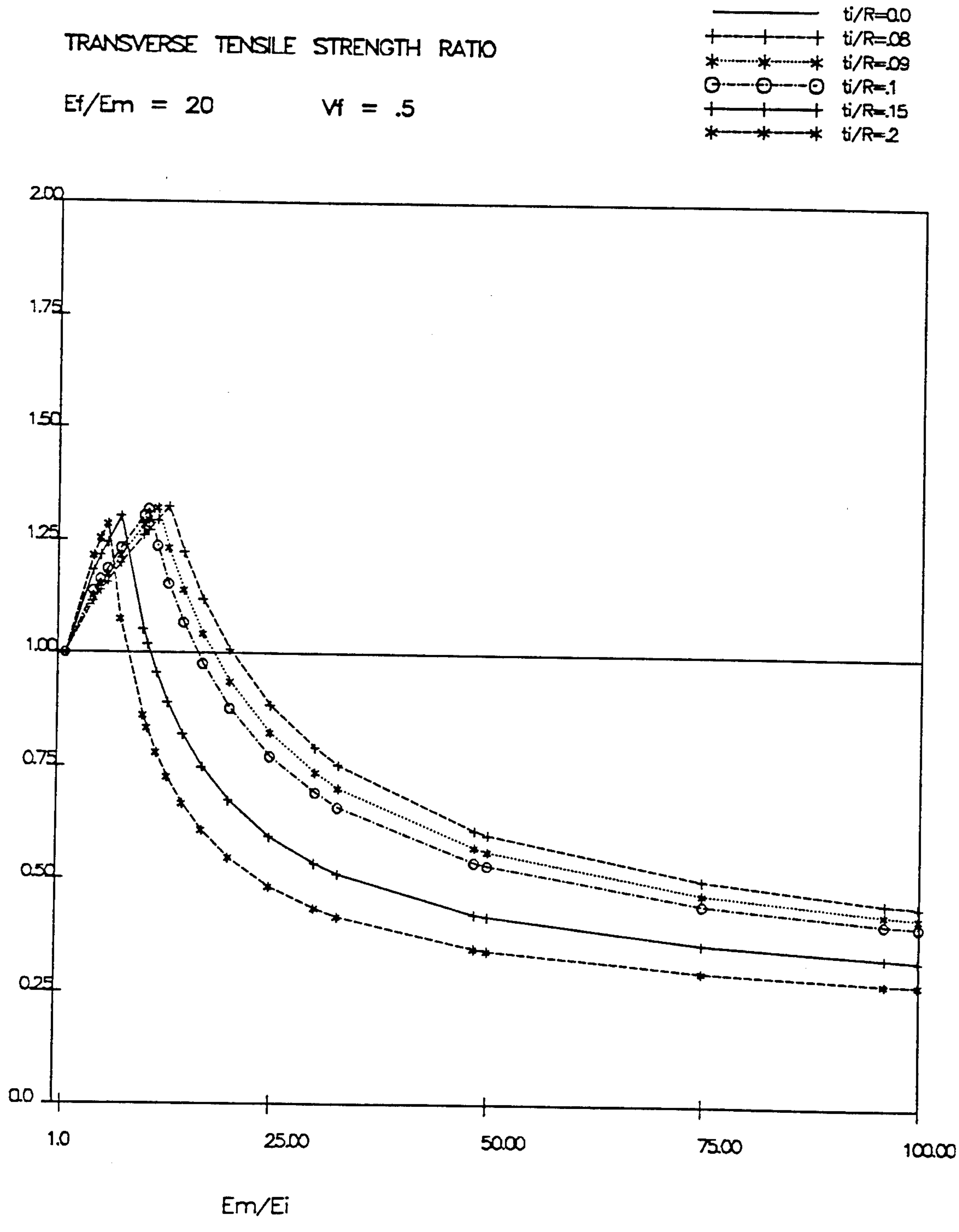

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

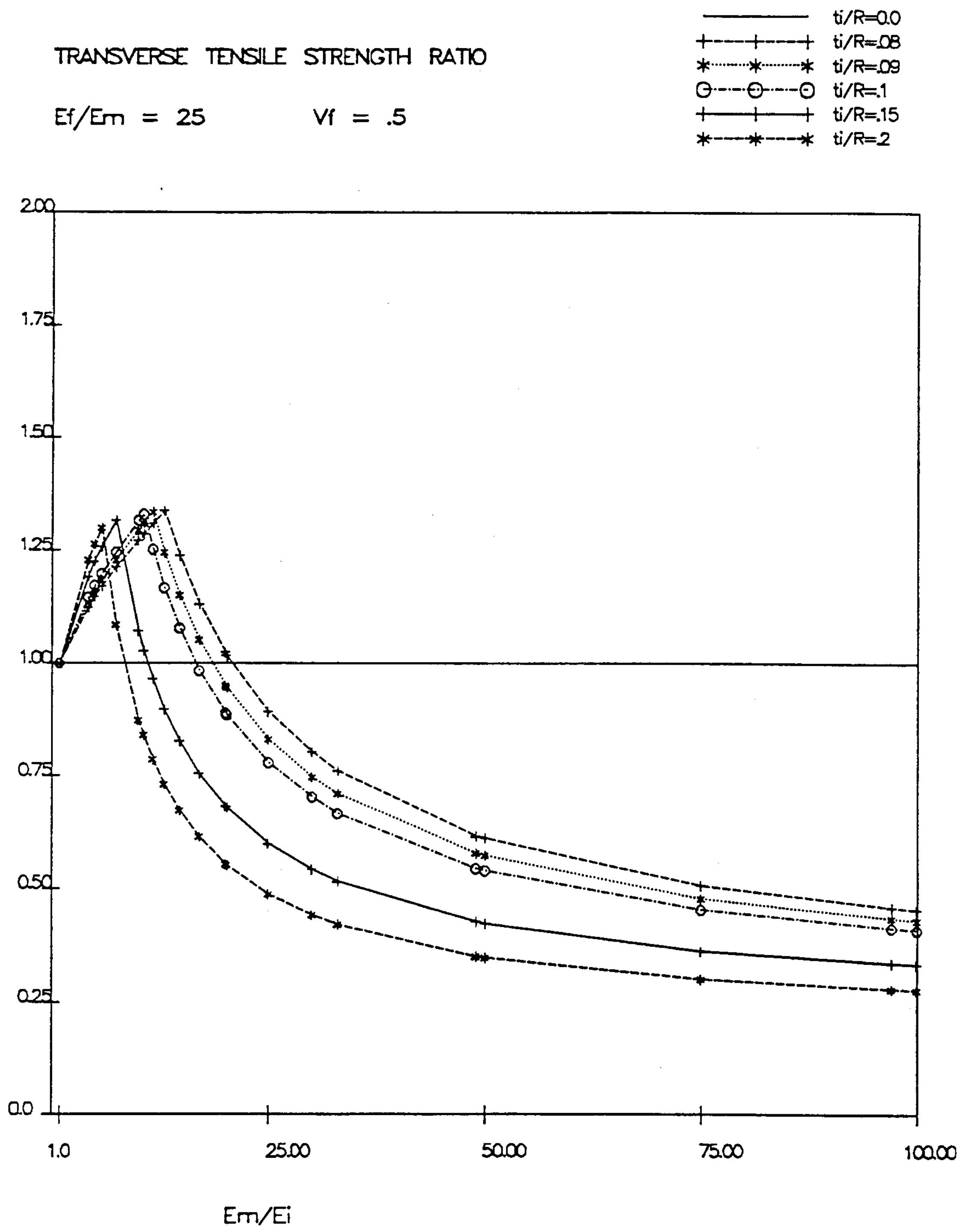


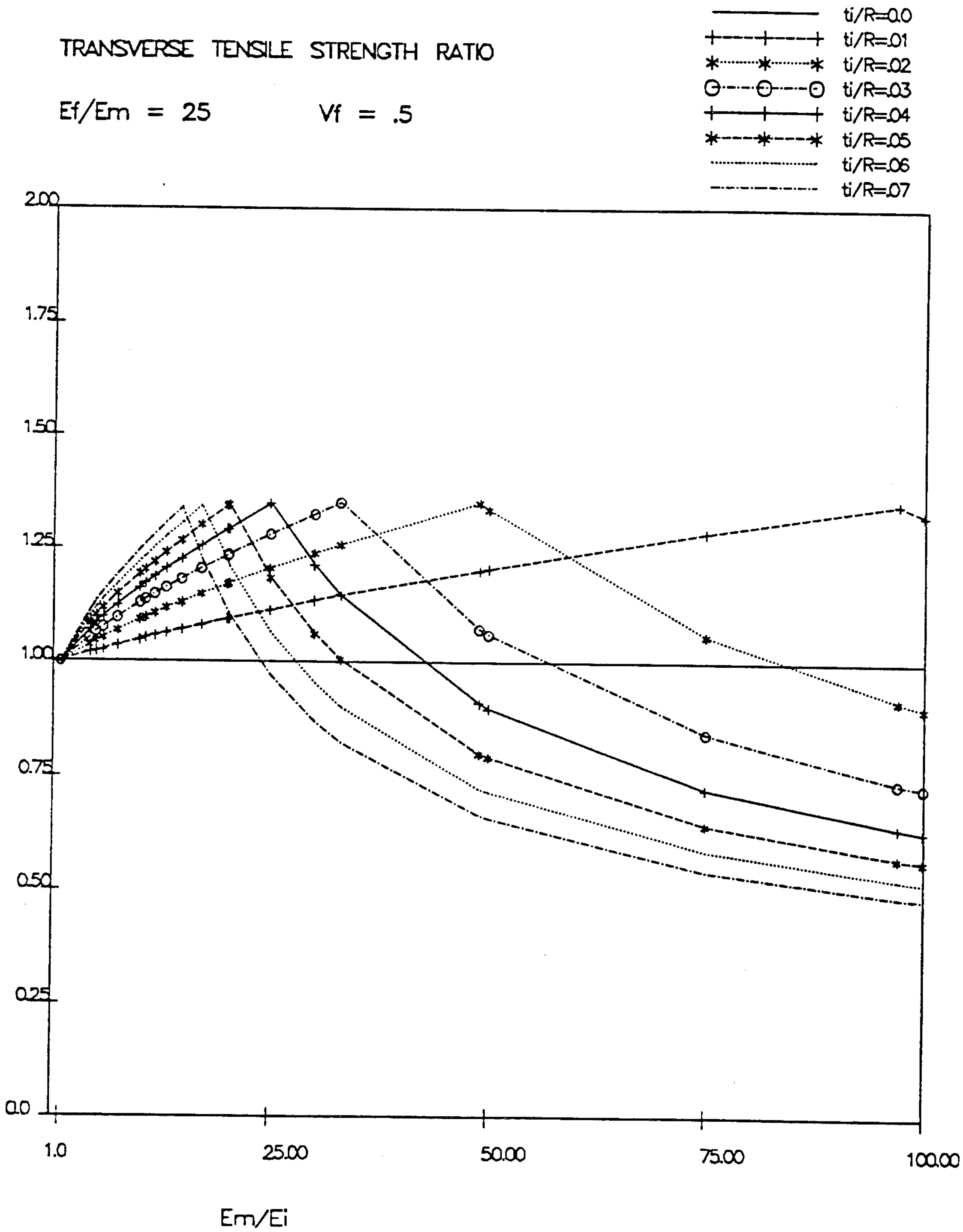
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

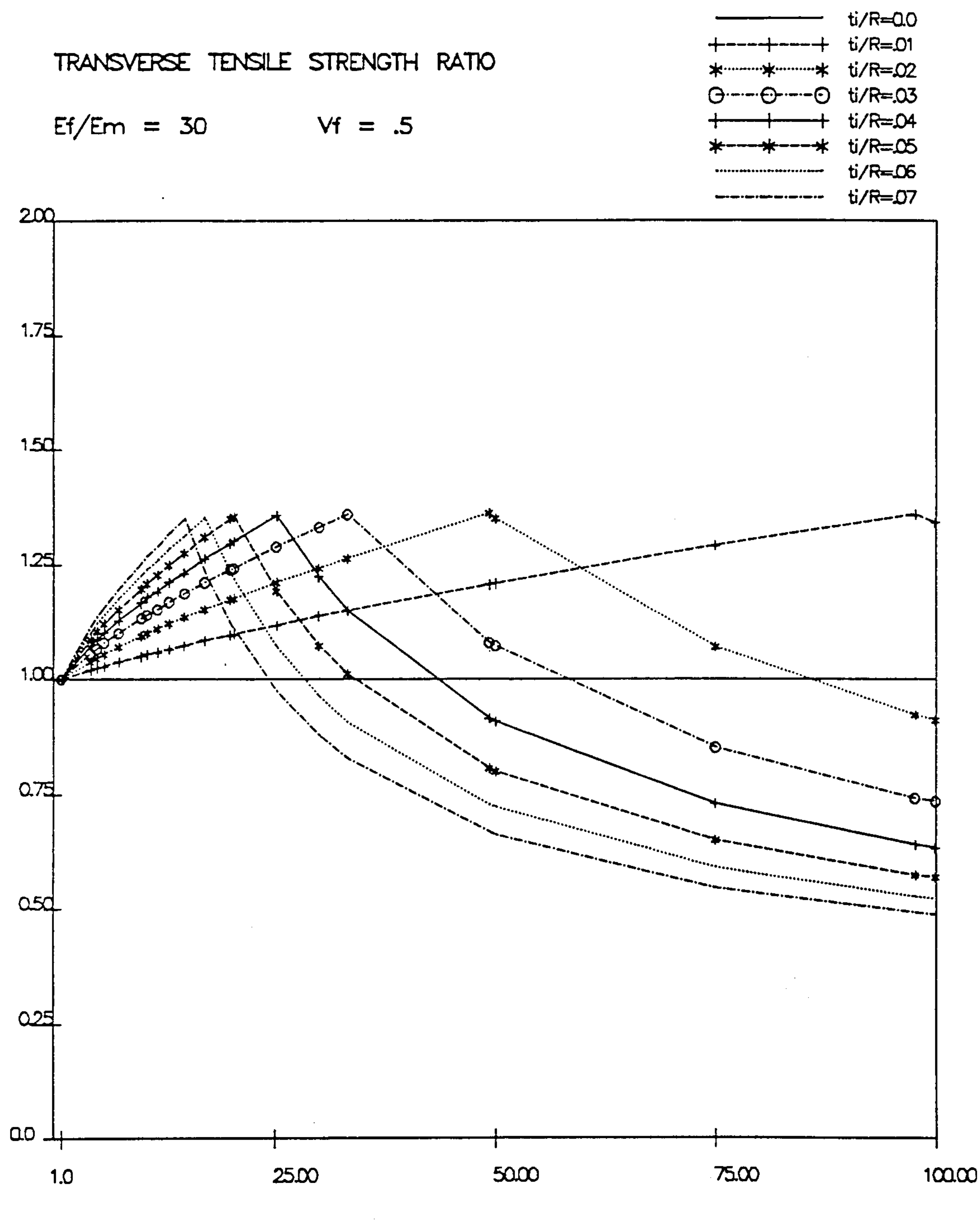


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

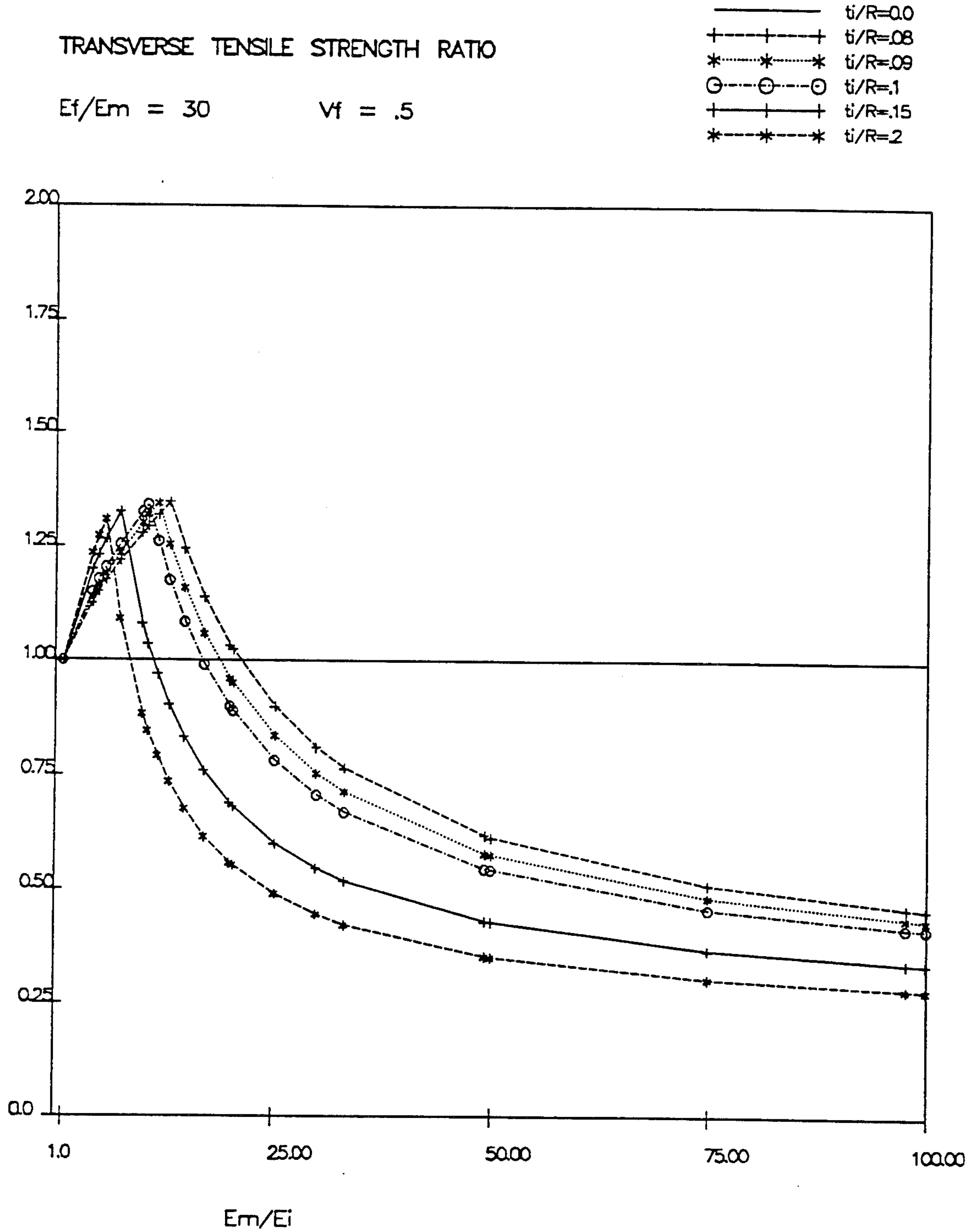

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

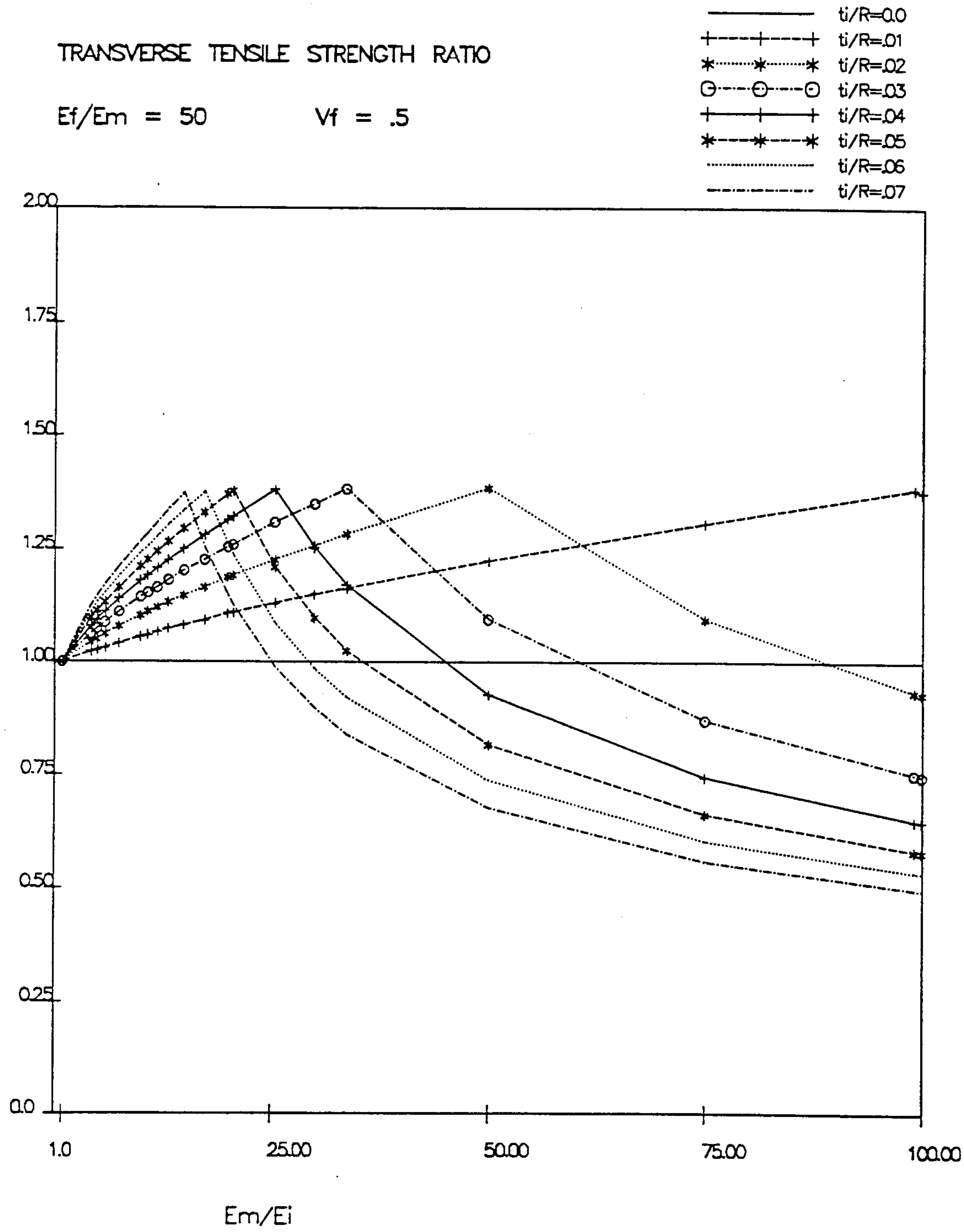

ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .5
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

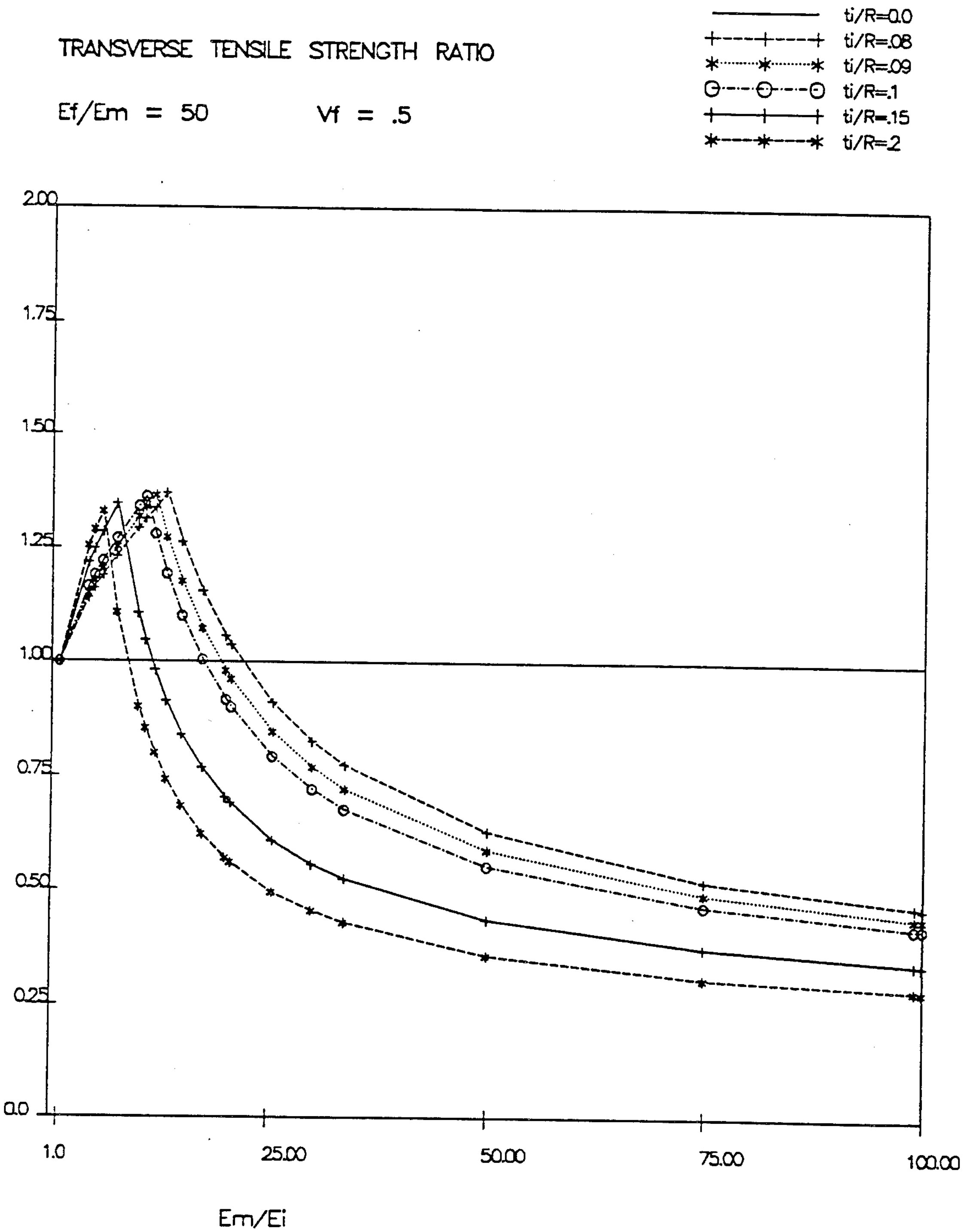


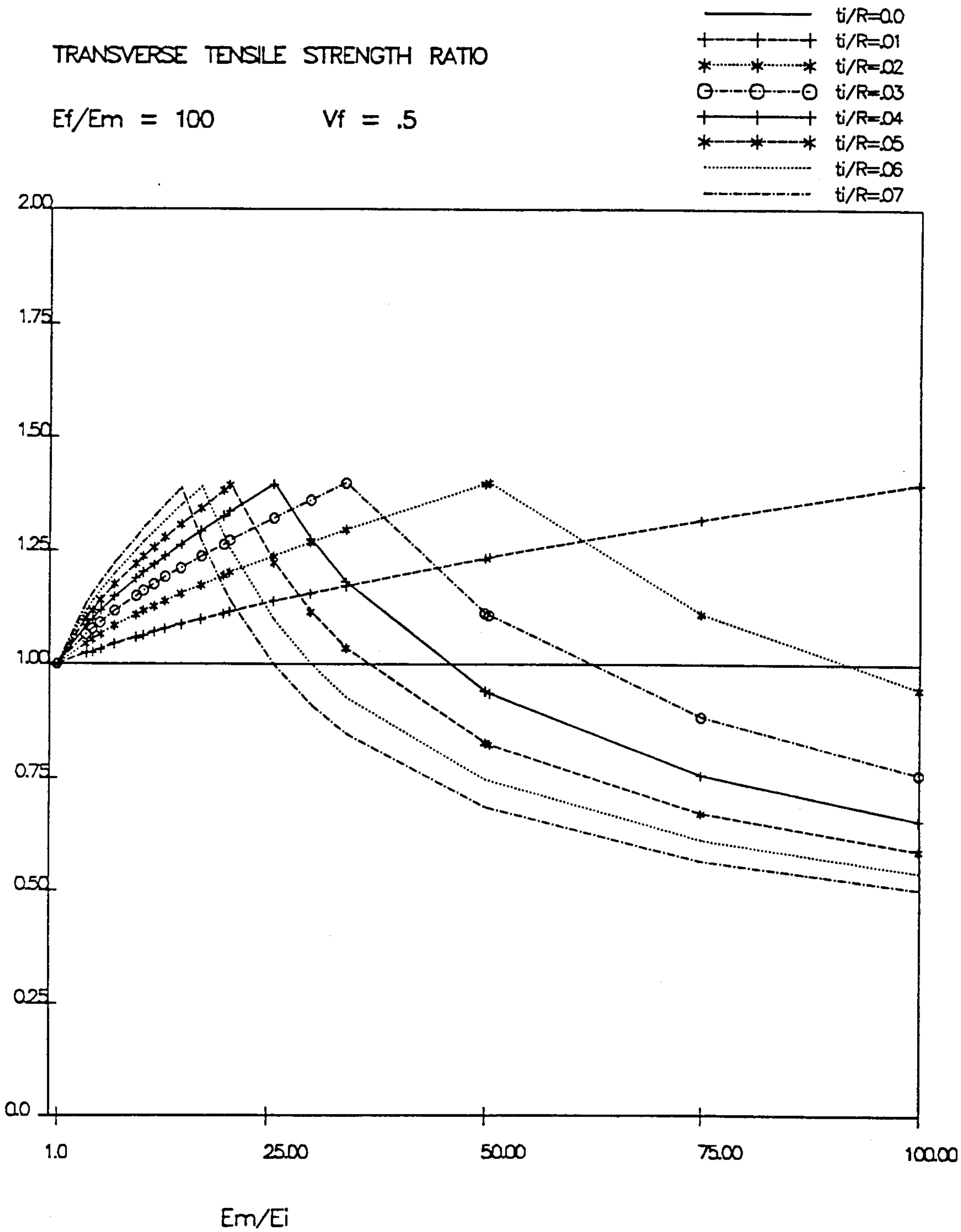
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

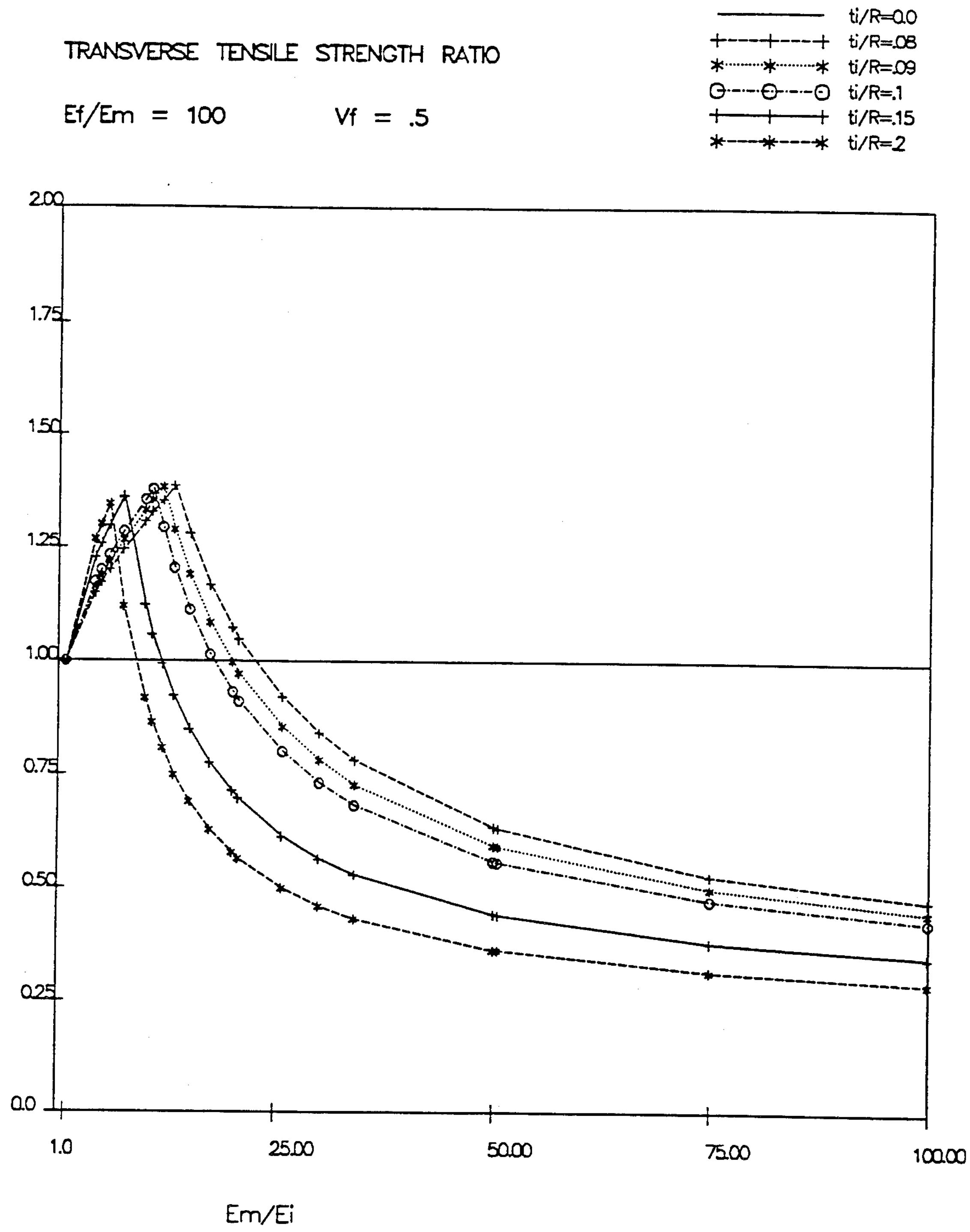

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .5
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .5
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
ti/R=.2
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

tratout   Thu Dec 17 14:14:21 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0   Vf = 0.50   max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.7	1.00	1.01	1.01	1.02	1.02	1.03	1.04	1.04
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.05	1.06
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.05	1.06
6.3	1.00	1.01	1.02	1.04	1.05	1.06	1.07	1.08
9.0	1.00	1.02	1.04	1.05	1.07	1.09	1.11	1.12
9.9	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14
10.0	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.14
11.0	1.00	1.02	1.05	1.07	1.09	1.11	1.13	1.15
12.4	1.00	1.02	1.05	1.08	1.10	1.13	1.15	1.17
14.3	1.00	1.03	1.06	1.09	1.12	1.15	1.18	1.09
17.0	1.00	1.04	1.07	1.11	1.14	1.18	1.07	0.99
20.0	1.00	1.04	1.09	1.13	1.17	1.08	0.98	0.90
21.0	1.00	1.04	1.09	1.14	1.18	1.05	0.96	0.88
27.7	1.00	1.06	1.12	1.18	1.02	0.91	0.82	0.75
30.0	1.00	1.06	1.13	1.13	0.98	0.87	0.78	0.72
41.0	1.00	1.09	1.18	0.96	0.83	0.73	0.66	0.61
50.0	1.00	1.11	1.07	0.87	0.74	0.66	0.60	0.55
75.0	1.00	1.17	0.87	0.70	0.61	0.54	0.49	0.46
81.0	1.00	1.18	0.83	0.67	0.58	0.52	0.48	0.44
100.0	1.00	1.06	0.75	0.61	0.53	0.48	0.44	0.41
Em/Ei cr		81.00	41.00	27.67	21.00	17.00	14.33	12.43

Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
3.7	1.05	1.05	1.06	1.08	1.10
5.0	1.07	1.08	1.09	1.12	1.14
5.0	1.07	1.08	1.09	1.12	1.14
6.3	1.09	1.10	1.11	1.15	0.97
9.0	1.14	1.15	1.17	0.93	0.77
9.9	1.15	1.17	1.11	0.87	0.72
10.0	1.15	1.16	1.10	0.87	0.72
11.0	1.17	1.10	1.04	0.82	0.67
12.4	1.09	1.03	0.97	0.76	0.62
14.3	1.01	0.95	0.89	0.69	0.57
17.0	0.92	0.86	0.81	0.63	0.51
20.0	0.84	0.78	0.73	0.57	0.47
21.0	0.81	0.76	0.71	0.55	0.45
27.7	0.70	0.65	0.61	0.48	0.39
30.0	0.67	0.62	0.59	0.46	0.37
41.0	0.57	0.53	0.50	0.39	0.32
50.0	0.51	0.48	0.45	0.36	0.30
75.0	0.43	0.41	0.38	0.31	0.26
81.0	0.42	0.39	0.37	0.30	0.25
100.0	0.39	0.37	0.35	0.28	0.24
Em/Ei cr	11.00	9.89	9.00	6.33	5.00

tratout Thu Dec 17 14:14:27 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.0	1.00	1.01	1.02	1.04	1.05	1.06	1.07	1.08
5.0	1.00	1.02	1.03	1.05	1.06	1.07	1.09	1.10
5.5	1.00	1.02	1.04	1.05	1.07	1.08	1.10	1.11
7.0	1.00	1.02	1.05	1.07	1.09	1.11	1.12	1.14
10.0	1.00	1.03	1.07	1.10	1.12	1.15	1.17	1.20
10.0	1.00	1.03	1.07	1.10	1.12	1.15	1.17	1.20
11.0	1.00	1.04	1.07	1.11	1.14	1.16	1.19	1.21
12.2	1.00	1.04	1.08	1.12	1.15	1.18	1.21	1.24
13.9	1.00	1.05	1.09	1.13	1.17	1.20	1.23	1.26
16.0	1.00	1.06	1.11	1.15	1.19	1.23	1.27	1.16
19.0	1.00	1.07	1.12	1.18	1.22	1.27	1.15	1.05
20.0	1.00	1.07	1.13	1.19	1.24	1.23	1.11	1.02
23.5	1.00	1.08	1.15	1.21	1.27	1.12	1.01	0.93
30.0	1.00	1.10	1.19	1.27	1.11	0.98	0.88	0.80
31.0	1.00	1.10	1.19	1.27	1.09	0.96	0.86	0.79
46.0	1.00	1.15	1.28	1.02	0.87	0.77	0.69	0.64
50.0	1.00	1.16	1.22	0.98	0.83	0.73	0.66	0.61
75.0	1.00	1.23	0.97	0.78	0.67	0.60	0.55	0.50
91.0	1.00	1.27	0.88	0.71	0.61	0.55	0.50	0.47
100.0	1.00	1.21	0.83	0.67	0.58	0.53	0.48	0.45
Em/Ei cr		91.00	46.00	31.00	23.50	19.00	16.00	13.86

Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.0	1.09	1.10	1.10	1.14	1.17
5.0	1.11	1.12	1.13	1.18	1.21
5.5	1.12	1.13	1.15	1.19	1.23
7.0	1.16	1.17	1.18	1.24	1.03
10.0	1.22	1.24	1.26	0.98	0.81
10.0	1.22	1.24	1.26	0.98	0.81
11.0	1.24	1.26	1.18	0.92	0.75
12.2	1.26	1.18	1.11	0.86	0.70
13.9	1.17	1.09	1.03	0.79	0.65
16.0	1.07	1.00	0.94	0.72	0.59
19.0	0.97	0.90	0.85	0.65	0.53
20.0	0.94	0.88	0.82	0.63	0.51
23.5	0.85	0.80	0.75	0.58	0.47
30.0	0.74	0.69	0.65	0.50	0.41
31.0	0.73	0.68	0.64	0.49	0.40
46.0	0.59	0.55	0.52	0.41	0.34
50.0	0.57	0.53	0.50	0.40	0.33
75.0	0.47	0.45	0.42	0.34	0.28
91.0	0.44	0.41	0.39	0.32	0.27
100.0	0.42	0.40	0.38	0.31	0.26
Em/Ei cr	12.25	11.00	10.00	7.00	5.50

tratout Thu Dec 17 14:14:31 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.02	1.03	1.05	1.07	1.08	1.09	1.11
5.0	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.13
5.8	1.00	1.03	1.05	1.07	1.09	1.11	1.13	1.15
7.3	1.00	1.03	1.06	1.09	1.12	1.14	1.16	1.18
10.0	1.00	1.05	1.09	1.12	1.16	1.19	1.21	1.24
10.5	1.00	1.05	1.09	1.13	1.16	1.19	1.22	1.25
11.6	1.00	1.05	1.10	1.14	1.18	1.21	1.24	1.27
12.9	1.00	1.06	1.11	1.16	1.19	1.23	1.26	1.29
14.6	1.00	1.07	1.12	1.17	1.22	1.26	1.29	1.33
16.8	1.00	1.08	1.14	1.19	1.24	1.29	1.33	1.21
20.0	1.00	1.09	1.16	1.23	1.28	1.33	1.20	1.09
20.0	1.00	1.09	1.16	1.23	1.28	1.33	1.20	1.09
24.8	1.00	1.11	1.19	1.27	1.33	1.17	1.05	0.96
30.0	1.00	1.13	1.23	1.31	1.19	1.05	0.94	0.86
32.7	1.00	1.14	1.24	1.34	1.13	1.00	0.89	0.82
48.5	1.00	1.19	1.34	1.06	0.90	0.80	0.72	0.66
50.0	1.00	1.20	1.32	1.05	0.89	0.78	0.71	0.65
75.0	1.00	1.27	1.04	0.83	0.71	0.64	0.58	0.54
96.0	1.00	1.34	0.91	0.73	0.63	0.57	0.52	0.48
100.0	1.00	1.31	0.89	0.72	0.62	0.56	0.51	0.48
Em/Ei cr		96.00	48.50	32.67	24.75	20.00	16.83	14.57

Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.2	1.12	1.13	1.14	1.18	1.22
5.0	1.14	1.15	1.17	1.22	1.26
5.8	1.16	1.18	1.19	1.25	1.29
7.3	1.20	1.22	1.23	1.30	1.08
10.0	1.26	1.28	1.31	1.05	0.86
10.5	1.27	1.30	1.32	1.02	0.83
11.6	1.30	1.32	1.24	0.96	0.78
12.9	1.32	1.23	1.16	0.89	0.72
14.6	1.23	1.14	1.07	0.82	0.67
16.8	1.12	1.04	0.98	0.75	0.61
20.0	1.01	0.94	0.88	0.67	0.55
20.0	1.01	0.94	0.88	0.67	0.55
24.8	0.89	0.82	0.77	0.59	0.48
30.0	0.79	0.74	0.69	0.53	0.44
32.7	0.75	0.70	0.66	0.51	0.42
48.5	0.61	0.57	0.54	0.42	0.35
50.0	0.60	0.56	0.53	0.42	0.34
75.0	0.50	0.47	0.45	0.36	0.30
96.0	0.46	0.43	0.41	0.33	0.28
100.0	0.45	0.43	0.40	0.33	0.28
Em/Ei cr	12.88	11.56	10.50	7.33	5.75

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.02	1.04	1.05	1.07	1.08	1.10	1.11
5.0	1.00	1.02	1.05	1.07	1.08	1.10	1.12	1.13
5.8	1.00	1.03	1.05	1.08	1.10	1.12	1.14	1.15
7.4	1.00	1.04	1.07	1.10	1.12	1.15	1.17	1.19
10.0	1.00	1.05	1.09	1.13	1.16	1.19	1.22	1.25
10.6	1.00	1.05	1.10	1.14	1.17	1.20	1.23	1.26
11.7	1.00	1.06	1.11	1.15	1.19	1.22	1.25	1.28
13.0	1.00	1.06	1.12	1.16	1.20	1.24	1.28	1.31
14.7	1.00	1.07	1.13	1.18	1.23	1.27	1.31	1.34
17.0	1.00	1.08	1.15	1.21	1.26	1.30	1.34	1.23
20.0	1.00	1.09	1.17	1.23	1.29	1.34	1.22	1.11
20.2	1.00	1.10	1.17	1.24	1.29	1.35	1.21	1.10
25.0	1.00	1.12	1.20	1.28	1.35	1.19	1.06	0.97
30.0	1.00	1.13	1.24	1.33	1.21	1.06	0.95	0.87
33.0	1.00	1.15	1.26	1.35	1.15	1.01	0.90	0.82
49.0	1.00	1.20	1.35	1.07	0.91	0.80	0.72	0.66
50.0	1.00	1.21	1.34	1.06	0.90	0.79	0.72	0.66
75.0	1.00	1.28	1.06	0.85	0.72	0.64	0.59	0.54
97.0	1.00	1.35	0.92	0.74	0.64	0.57	0.52	0.49
100.0	1.00	1.33	0.90	0.73	0.63	0.56	0.52	0.48
Em/Ei cr		97.00	49.00	33.00	25.00	20.20	17.00	14.71

Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.2	1.12	1.14	1.15	1.19	1.23
5.0	1.15	1.16	1.17	1.23	1.27
5.8	1.17	1.19	1.20	1.26	1.30
7.4	1.21	1.23	1.25	1.32	1.09
10.0	1.27	1.30	1.32	1.07	0.88
10.6	1.29	1.31	1.33	1.03	0.84
11.7	1.31	1.34	1.25	0.96	0.79
13.0	1.34	1.25	1.17	0.90	0.73
14.7	1.24	1.15	1.08	0.83	0.67
17.0	1.13	1.05	0.99	0.75	0.61
20.0	1.02	0.95	0.89	0.68	0.55
20.2	1.02	0.95	0.89	0.68	0.55
25.0	0.89	0.83	0.78	0.60	0.49
30.0	0.80	0.75	0.70	0.54	0.44
33.0	0.76	0.71	0.67	0.52	0.42
49.0	0.62	0.58	0.54	0.43	0.35
50.0	0.61	0.57	0.54	0.42	0.35
75.0	0.51	0.48	0.45	0.36	0.30
97.0	0.46	0.44	0.41	0.34	0.28
100.0	0.45	0.43	0.41	0.33	0.28
Em/Ei cr	13.00	11.67	10.60	7.40	5.80

tratout Thu Dec 17 14:14:41 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.02	1.04	1.06	1.07	1.09	1.10	1.12
5.0	1.00	1.02	1.05	1.07	1.09	1.11	1.12	1.14
5.8	1.00	1.03	1.06	1.08	1.10	1.12	1.14	1.16
7.4	1.00	1.04	1.07	1.10	1.13	1.15	1.18	1.20
10.0	1.00	1.05	1.10	1.13	1.17	1.20	1.23	1.26
10.7	1.00	1.05	1.10	1.14	1.18	1.21	1.24	1.27
11.7	1.00	1.06	1.11	1.15	1.19	1.23	1.26	1.29
13.1	1.00	1.07	1.12	1.17	1.21	1.25	1.29	1.32
14.8	1.00	1.08	1.14	1.19	1.23	1.28	1.32	1.35
17.1	1.00	1.09	1.15	1.21	1.26	1.31	1.35	1.24
20.0	1.00	1.10	1.18	1.24	1.30	1.35	1.23	1.12
20.3	1.00	1.10	1.18	1.24	1.30	1.36	1.22	1.11
25.2	1.00	1.12	1.21	1.29	1.36	1.19	1.07	0.98
30.0	1.00	1.14	1.24	1.33	1.23	1.07	0.96	0.88
33.2	1.00	1.15	1.26	1.36	1.15	1.01	0.91	0.83
49.3	1.00	1.21	1.36	1.08	0.92	0.81	0.73	0.67
50.0	1.00	1.21	1.35	1.07	0.91	0.80	0.72	0.66
75.0	1.00	1.29	1.07	0.85	0.73	0.65	0.59	0.55
97.7	1.00	1.36	0.92	0.74	0.64	0.58	0.53	0.49
100.0	1.00	1.34	0.91	0.73	0.63	0.57	0.52	0.49
Em/Ei cr		97.67	49.33	33.22	25.17	20.33	17.11	14.81

Em/Ei	ti / R = 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.2	1.13	1.14	1.15	1.20	1.24
5.0	1.15	1.17	1.18	1.23	1.27
5.8	1.18	1.19	1.21	1.27	1.31
7.4	1.22	1.24	1.25	1.33	1.09
10.0	1.28	1.30	1.32	1.08	0.88
10.7	1.30	1.32	1.34	1.04	0.85
11.7	1.32	1.35	1.26	0.97	0.79
13.1	1.35	1.26	1.18	0.90	0.73
14.8	1.25	1.16	1.09	0.83	0.68
17.1	1.14	1.06	0.99	0.76	0.62
20.0	1.03	0.96	0.90	0.69	0.56
20.3	1.02	0.95	0.89	0.68	0.55
25.2	0.90	0.84	0.78	0.60	0.49
30.0	0.81	0.76	0.71	0.55	0.45
33.2	0.77	0.71	0.67	0.52	0.42
49.3	0.62	0.58	0.55	0.43	0.35
50.0	0.62	0.58	0.54	0.43	0.35
75.0	0.51	0.48	0.46	0.37	0.31
97.7	0.46	0.44	0.42	0.34	0.28
100.0	0.46	0.43	0.41	0.34	0.28
Em/Ei cr	13.08	11.74	10.67	7.44	5.83

tratout **Thu Dec 17 14:14:46 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.13
5.0	1.00	1.03	1.05	1.07	1.09	1.11	1.13	1.15
5.9	1.00	1.03	1.06	1.09	1.11	1.13	1.15	1.17
7.5	1.00	1.04	1.08	1.11	1.14	1.17	1.19	1.21
10.0	1.00	1.06	1.10	1.14	1.18	1.21	1.24	1.27
10.8	1.00	1.06	1.11	1.15	1.19	1.23	1.26	1.29
11.9	1.00	1.07	1.12	1.17	1.21	1.24	1.28	1.31
13.3	1.00	1.07	1.13	1.18	1.23	1.27	1.30	1.34
15.0	1.00	1.08	1.15	1.20	1.25	1.29	1.34	1.37
17.3	1.00	1.09	1.17	1.23	1.28	1.33	1.38	1.25
20.0	1.00	1.11	1.19	1.25	1.32	1.37	1.26	1.15
20.6	1.00	1.11	1.19	1.26	1.32	1.38	1.24	1.13
25.5	1.00	1.13	1.23	1.31	1.38	1.21	1.09	0.99
30.0	1.00	1.15	1.26	1.35	1.25	1.10	0.98	0.90
33.7	1.00	1.16	1.28	1.38	1.17	1.03	0.92	0.84
50.0	1.00	1.22	1.38	1.10	0.93	0.82	0.74	0.68
50.0	1.00	1.22	1.38	1.10	0.93	0.82	0.74	0.68
75.0	1.00	1.31	1.09	0.87	0.74	0.66	0.60	0.56
99.0	1.00	1.38	0.94	0.75	0.65	0.58	0.53	0.50
100.0	1.00	1.37	0.93	0.75	0.65	0.58	0.53	0.50
Em/Ei cr		99.00	50.00	33.67	25.50	20.60	17.33	15.00

Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.3	1.14	1.15	1.17	1.22	1.25
5.0	1.16	1.18	1.19	1.25	1.29
5.9	1.19	1.21	1.22	1.29	1.33
7.5	1.23	1.25	1.27	1.35	1.11
10.0	1.30	1.32	1.34	1.11	0.90
10.8	1.31	1.34	1.36	1.05	0.86
11.9	1.34	1.37	1.28	0.98	0.80
13.3	1.37	1.27	1.19	0.91	0.74
15.0	1.27	1.18	1.10	0.84	0.68
17.3	1.16	1.07	1.00	0.77	0.62
20.0	1.06	0.98	0.92	0.70	0.57
20.6	1.04	0.96	0.90	0.69	0.56
25.5	0.91	0.85	0.79	0.61	0.50
30.0	0.83	0.77	0.72	0.56	0.45
33.7	0.77	0.72	0.68	0.52	0.43
50.0	0.63	0.59	0.55	0.44	0.36
50.0	0.63	0.59	0.55	0.44	0.36
75.0	0.52	0.49	0.47	0.37	0.31
99.0	0.47	0.44	0.42	0.34	0.29
100.0	0.47	0.44	0.42	0.34	0.29
Em/Ei cr	13.25	11.89	10.80	7.53	5.90

tratout Thu Dec 17 14:14:52 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

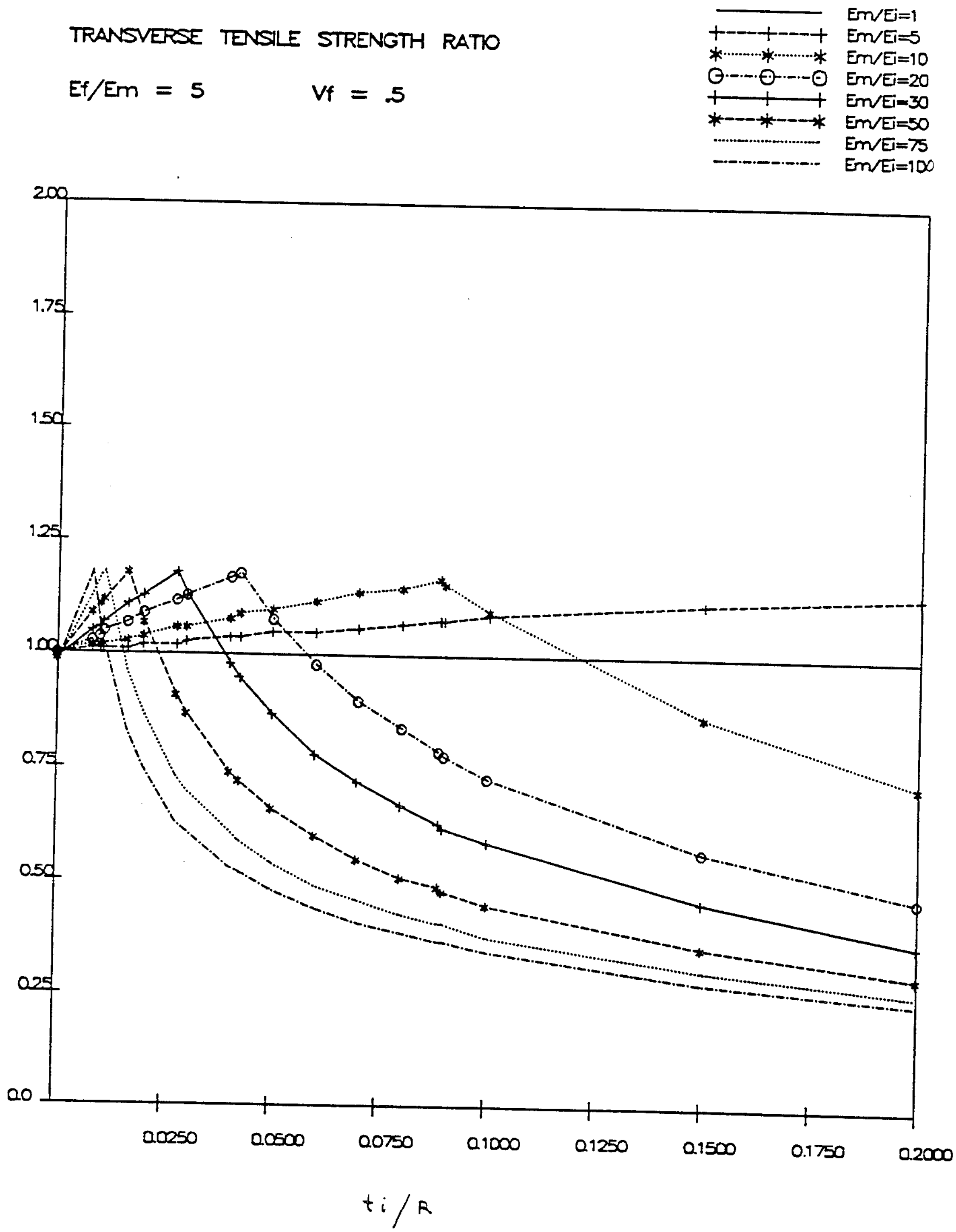
TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em =100.0 Vf = 0.50 max ti/R = 0.253

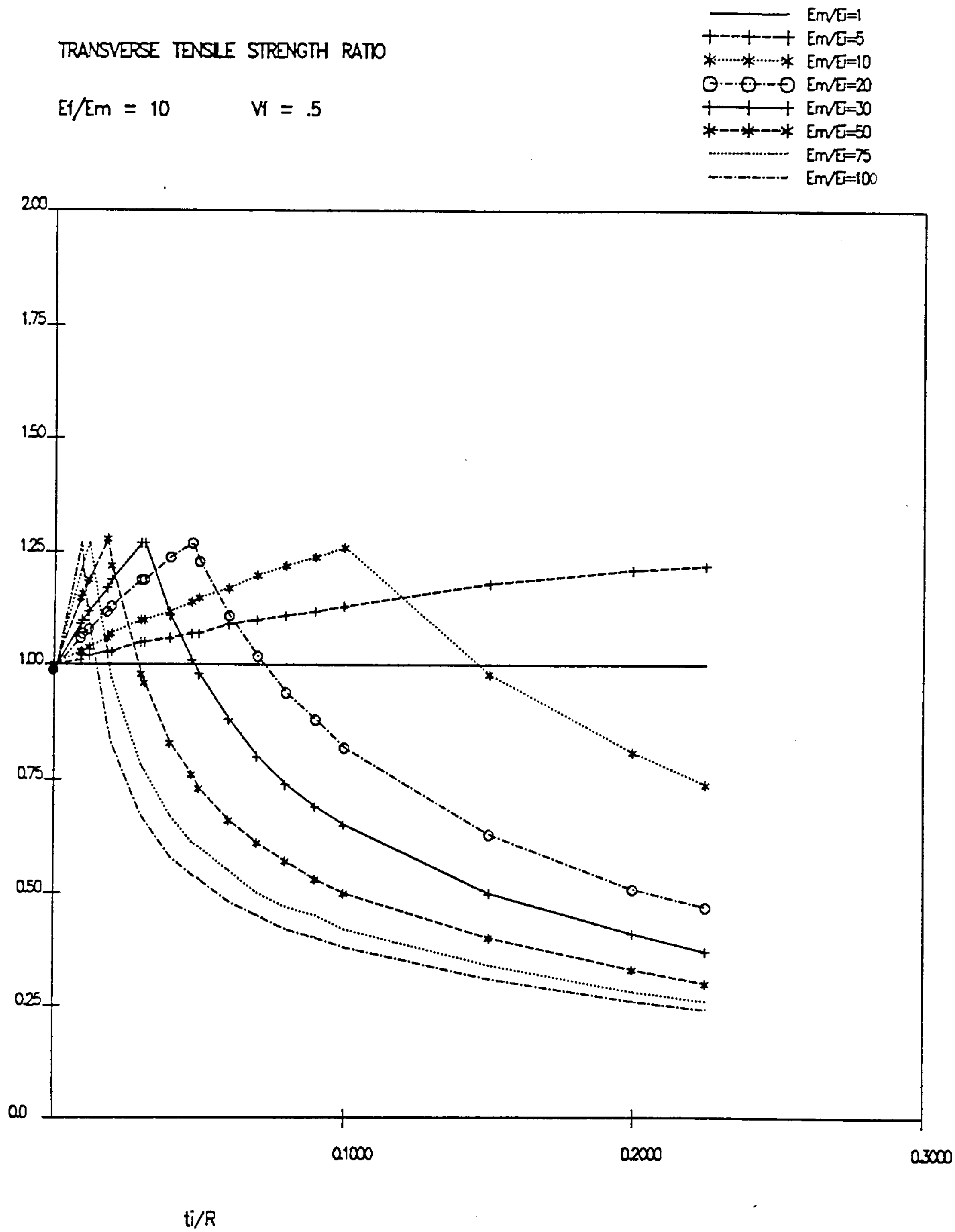
TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.02	1.05	1.07	1.09	1.10	1.12	1.13
5.0	1.00	1.03	1.05	1.08	1.10	1.12	1.14	1.16
5.9	1.00	1.03	1.07	1.09	1.12	1.14	1.16	1.18
7.6	1.00	1.04	1.08	1.12	1.15	1.18	1.20	1.23
10.0	1.00	1.06	1.11	1.15	1.19	1.22	1.25	1.28
10.9	1.00	1.06	1.12	1.16	1.20	1.24	1.27	1.30
12.0	1.00	1.07	1.13	1.18	1.22	1.26	1.29	1.33
13.4	1.00	1.08	1.14	1.19	1.24	1.28	1.32	1.35
15.1	1.00	1.09	1.16	1.21	1.26	1.31	1.35	1.39
17.5	1.00	1.10	1.18	1.24	1.30	1.35	1.39	1.27
20.0	1.00	1.11	1.20	1.27	1.33	1.38	1.28	1.17
20.8	1.00	1.12	1.20	1.27	1.34	1.40	1.25	1.14
25.8	1.00	1.14	1.24	1.32	1.40	1.23	1.10	1.00
30.0	1.00	1.16	1.27	1.36	1.28	1.12	1.00	0.91
34.0	1.00	1.17	1.30	1.40	1.18	1.04	0.93	0.85
50.0	1.00	1.23	1.40	1.12	0.94	0.83	0.75	0.69
50.5	1.00	1.24	1.40	1.11	0.94	0.83	0.74	0.68
75.0	1.00	1.32	1.11	0.88	0.76	0.67	0.61	0.57
100.0	1.00	1.40	0.95	0.76	0.66	0.59	0.54	0.50
100.0	1.00	1.40	0.95	0.76	0.66	0.59	0.54	0.50
Em/Ei cr		100.00	50.50	34.00	25.75	20.80	17.50	15.14

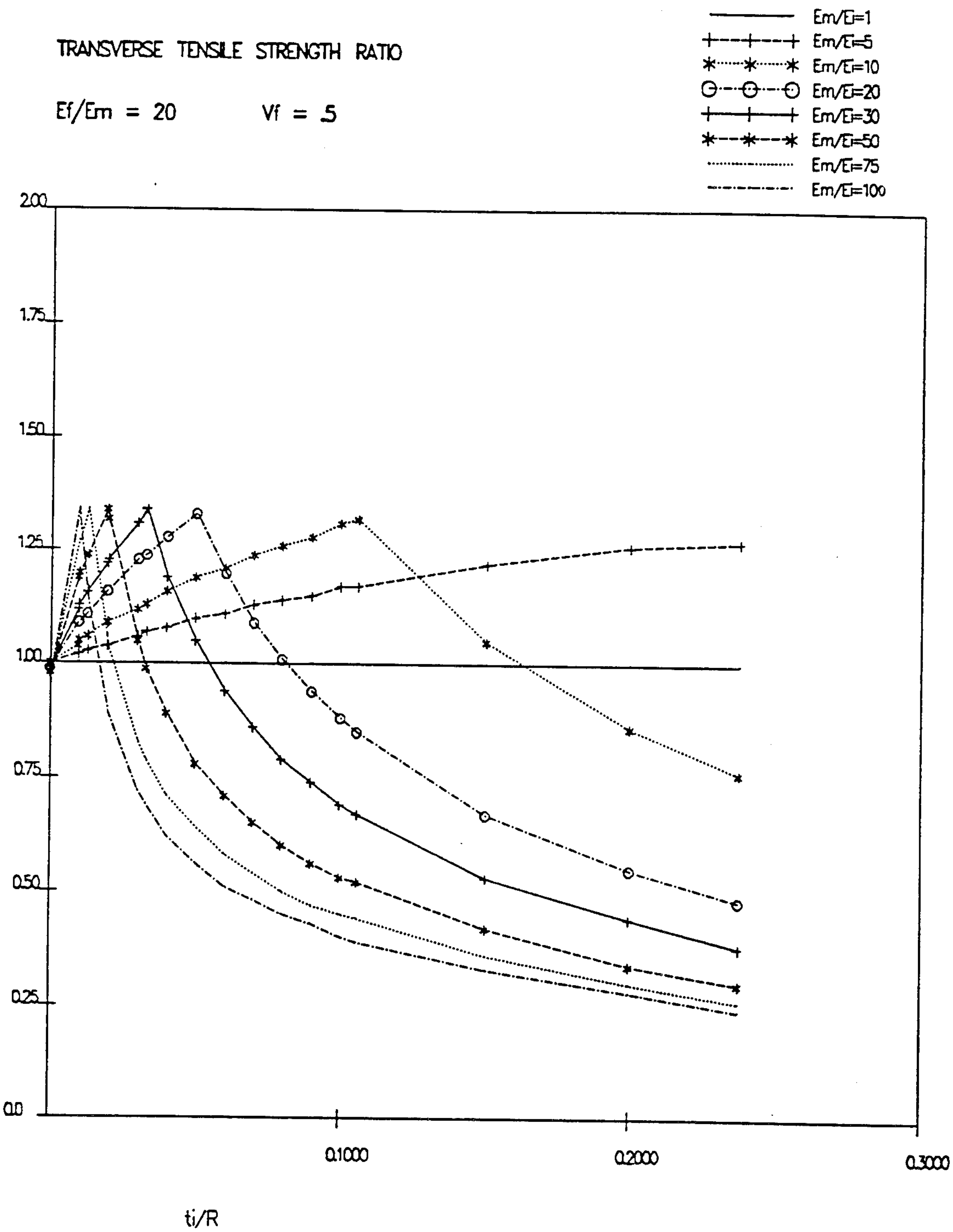
Em/Ei	ti / R 0.08	0.09	0.10	0.15	0.20
1.0	1.00	1.00	1.00	1.00	1.00
4.3	1.15	1.16	1.18	1.23	1.27
5.0	1.17	1.19	1.20	1.26	1.30
5.9	1.20	1.22	1.23	1.30	1.35
7.6	1.25	1.27	1.29	1.36	1.12
10.0	1.31	1.33	1.36	1.13	0.92
10.9	1.33	1.36	1.38	1.06	0.86
12.0	1.36	1.38	1.30	0.99	0.81
13.4	1.39	1.29	1.21	0.92	0.75
15.1	1.28	1.19	1.11	0.85	0.69
17.5	1.17	1.09	1.02	0.78	0.63
20.0	1.07	1.00	0.93	0.71	0.58
20.8	1.05	0.97	0.91	0.70	0.57
25.8	0.92	0.86	0.80	0.61	0.50
30.0	0.84	0.78	0.73	0.57	0.46
34.0	0.78	0.73	0.68	0.53	0.43
50.0	0.64	0.60	0.56	0.44	0.36
50.5	0.63	0.59	0.56	0.44	0.36
75.0	0.53	0.50	0.47	0.38	0.31
100.0	0.47	0.45	0.43	0.35	0.29
100.0	0.47	0.45	0.43	0.35	0.29
Em/Ei cr	13.38	12.00	10.90	7.60	5.95

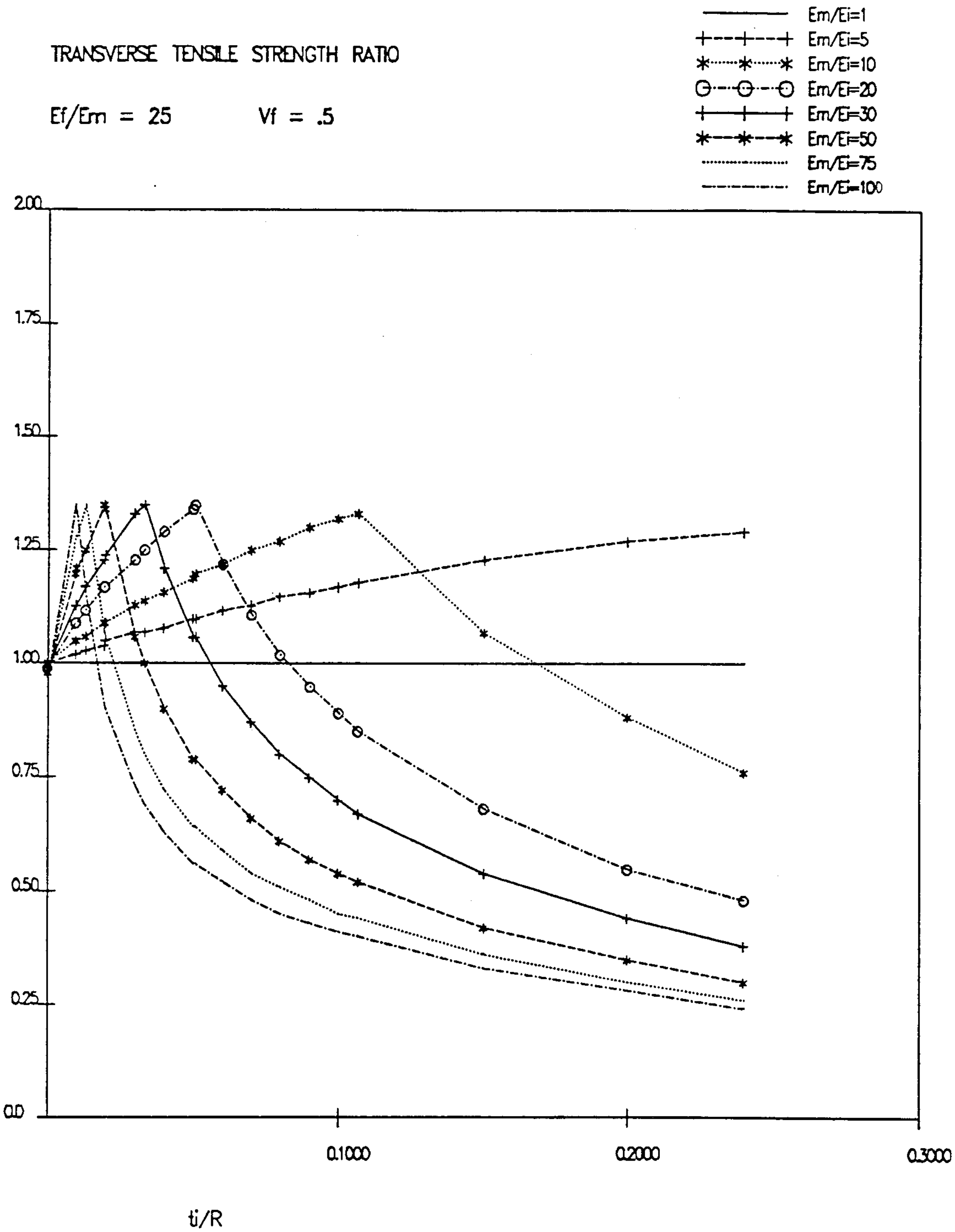


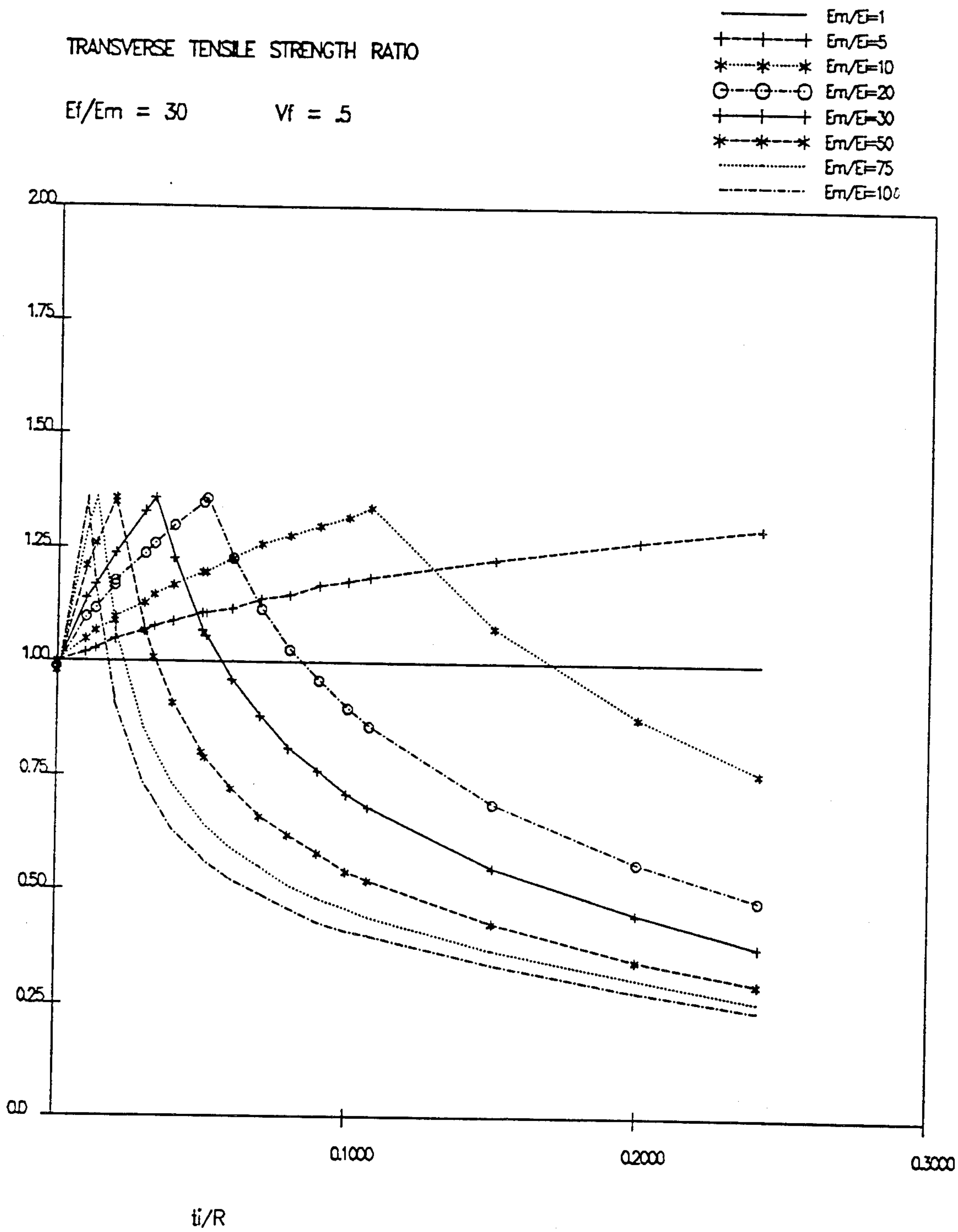
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R

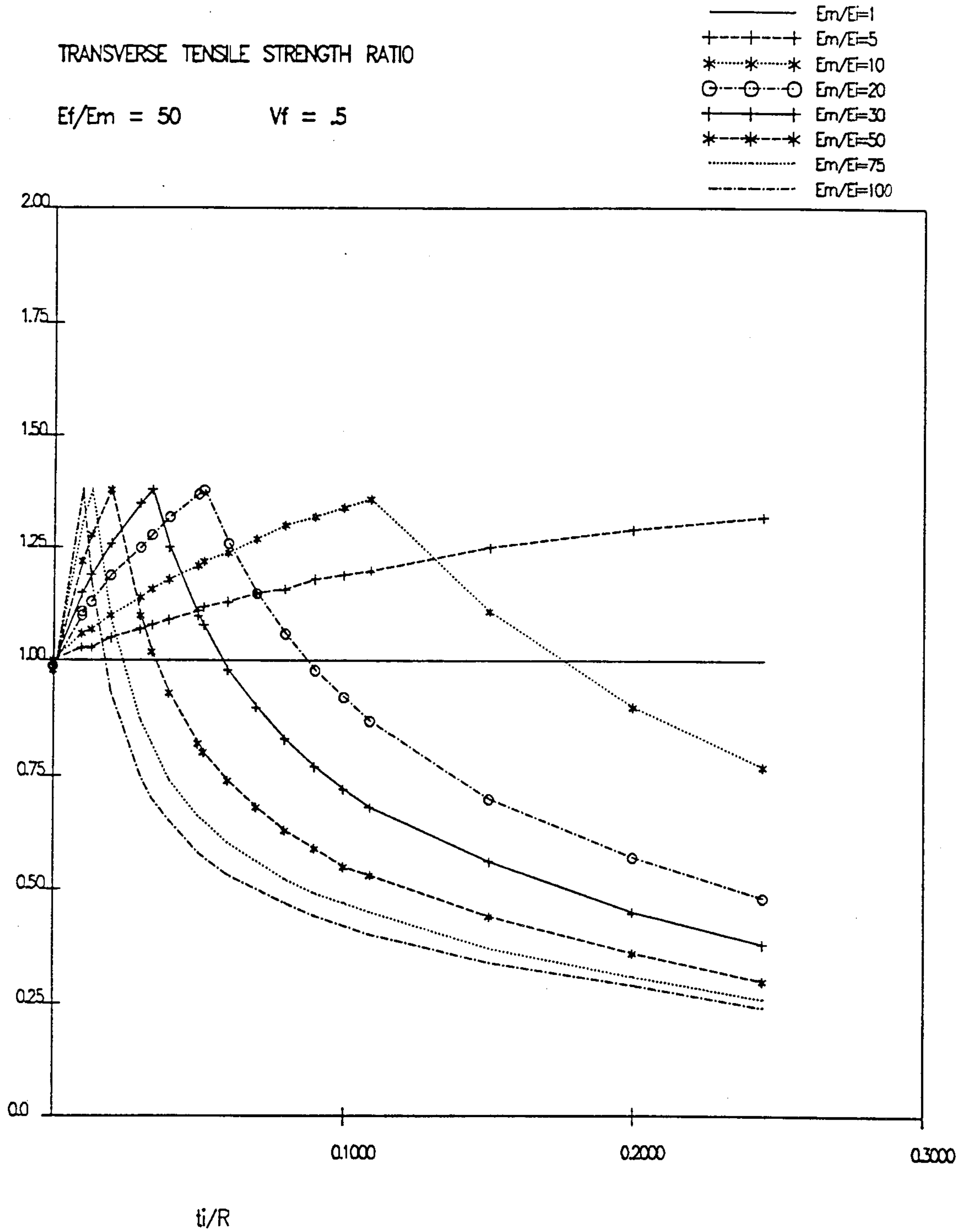


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10 Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R

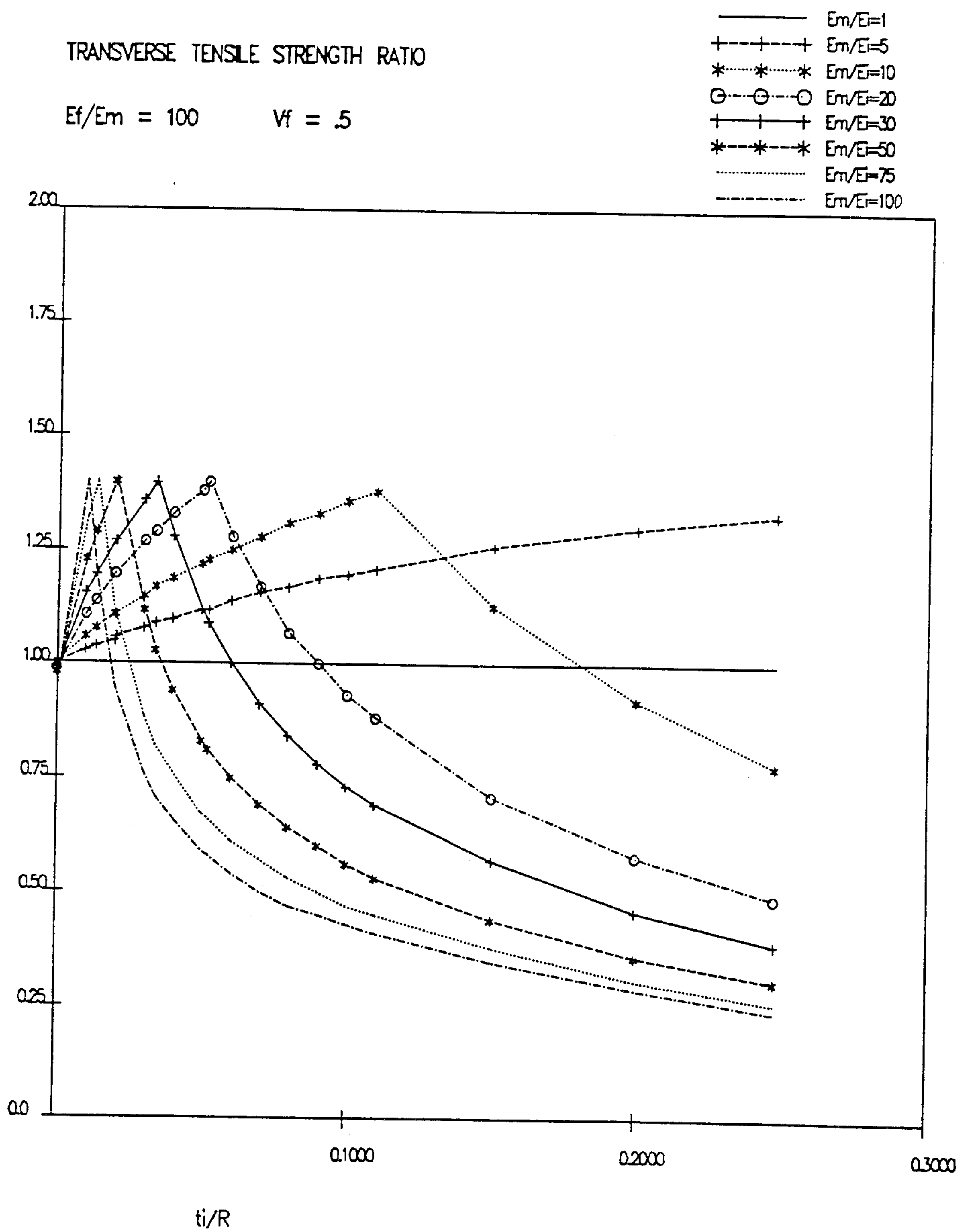

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100 Vf = .5
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.1000
0.2000
0.3000
ti/R

tratout Fri Dec 18 14:24:18 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	1.00	0.99	0.99	0.98	0.98
0.008	1.00	1.01	1.02	1.03	1.05	1.09	1.13	1.18
0.010	1.00	1.01	1.02	1.04	1.06	1.11	1.17	1.06
0.011	1.00	1.01	1.02	1.05	1.07	1.12	1.18	1.02
0.016	1.00	1.01	1.03	1.07	1.11	1.18	0.96	0.83
0.020	1.00	1.02	1.04	1.09	1.13	1.07	0.87	0.75
0.028	1.00	1.02	1.06	1.12	1.18	0.91	0.73	0.63
0.030	1.00	1.03	1.06	1.13	1.13	0.87	0.70	0.61
0.040	1.00	1.04	1.08	1.17	0.98	0.74	0.61	0.53
0.042	1.00	1.04	1.09	1.18	0.95	0.72	0.59	0.52
0.050	1.00	1.05	1.10	1.08	0.87	0.66	0.54	0.48
0.060	1.00	1.05	1.12	0.98	0.78	0.60	0.49	0.44
0.070	1.00	1.06	1.14	0.90	0.72	0.55	0.46	0.41
0.080	1.00	1.07	1.15	0.84	0.67	0.51	0.43	0.39
0.089	1.00	1.08	1.17	0.79	0.63	0.49	0.41	0.37
0.090	1.00	1.08	1.16	0.78	0.62	0.48	0.41	0.37
0.100	1.00	1.09	1.10	0.73	0.59	0.45	0.38	0.35
0.150	1.00	1.12	0.87	0.57	0.46	0.36	0.31	0.28
0.200	1.00	1.14	0.72	0.47	0.37	0.30	0.26	0.24
0.200	1.00	1.14	0.72	0.47	0.37	0.30	0.26	0.24
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout   Fri Dec 18 14:24:23 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0   Vf = 0.50   max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97
0.009	1.00	1.01	1.03	1.06	1.09	1.15	1.21	1.27
0.010	1.00	1.02	1.03	1.07	1.10	1.16	1.23	1.21
0.012	1.00	1.02	1.04	1.08	1.12	1.19	1.27	1.09
0.018	1.00	1.03	1.06	1.12	1.17	1.28	1.02	0.87
0.020	1.00	1.03	1.07	1.13	1.19	1.22	0.97	0.83
0.030	1.00	1.05	1.10	1.19	1.27	0.98	0.78	0.67
0.031	1.00	1.05	1.10	1.19	1.27	0.96	0.77	0.66
0.040	1.00	1.06	1.12	1.24	1.11	0.83	0.67	0.58
0.047	1.00	1.07	1.14	1.27	1.01	0.76	0.61	0.54
0.050	1.00	1.07	1.15	1.23	0.98	0.73	0.60	0.53
0.060	1.00	1.09	1.17	1.11	0.88	0.66	0.55	0.48
0.070	1.00	1.10	1.20	1.02	0.80	0.61	0.50	0.45
0.080	1.00	1.11	1.22	0.94	0.74	0.57	0.47	0.42
0.090	1.00	1.12	1.24	0.88	0.69	0.53	0.45	0.40
0.100	1.00	1.13	1.26	0.82	0.65	0.50	0.42	0.38
0.100	1.00	1.13	1.26	0.82	0.65	0.50	0.42	0.38
0.150	1.00	1.18	0.98	0.63	0.50	0.40	0.34	0.31
0.200	1.00	1.21	0.81	0.51	0.41	0.33	0.28	0.26
0.225	1.00	1.22	0.74	0.47	0.37	0.30	0.26	0.24
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout Fri Dec 18 14:24:28 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.97
0.010	1.00	1.02	1.04	1.09	1.12	1.19	1.27	1.34
0.010	1.00	1.02	1.05	1.09	1.13	1.20	1.27	1.31
0.013	1.00	1.03	1.06	1.11	1.16	1.24	1.34	1.14
0.019	1.00	1.04	1.09	1.16	1.22	1.34	1.06	0.91
0.020	1.00	1.04	1.09	1.16	1.23	1.32	1.04	0.89
0.030	1.00	1.06	1.12	1.23	1.31	1.05	0.83	0.72
0.033	1.00	1.07	1.13	1.24	1.34	0.99	0.79	0.69
0.040	1.00	1.08	1.16	1.28	1.19	0.89	0.71	0.62
0.050	1.00	1.10	1.19	1.33	1.05	0.78	0.64	0.56
0.050	1.00	1.10	1.19	1.33	1.05	0.78	0.64	0.56
0.060	1.00	1.11	1.21	1.20	0.94	0.71	0.58	0.51
0.070	1.00	1.13	1.24	1.09	0.86	0.65	0.54	0.48
0.080	1.00	1.14	1.26	1.01	0.79	0.60	0.50	0.45
0.090	1.00	1.15	1.28	0.94	0.74	0.56	0.47	0.43
0.100	1.00	1.17	1.31	0.88	0.69	0.53	0.45	0.40
0.106	1.00	1.17	1.32	0.85	0.67	0.52	0.44	0.39
0.150	1.00	1.22	1.05	0.67	0.53	0.42	0.36	0.33
0.200	1.00	1.26	0.86	0.55	0.44	0.34	0.30	0.28
0.237	1.00	1.27	0.76	0.48	0.38	0.30	0.26	0.24
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout Fri Dec 18 14:24:34 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.97
0.010	1.00	1.02	1.05	1.09	1.13	1.20	1.28	1.35
0.010	1.00	1.02	1.05	1.09	1.13	1.21	1.28	1.33
0.013	1.00	1.03	1.06	1.12	1.17	1.25	1.35	1.15
0.020	1.00	1.04	1.09	1.17	1.23	1.35	1.07	0.91
0.020	1.00	1.05	1.09	1.17	1.24	1.34	1.06	0.90
0.030	1.00	1.07	1.13	1.23	1.33	1.06	0.85	0.73
0.033	1.00	1.07	1.14	1.25	1.35	1.00	0.80	0.69
0.040	1.00	1.08	1.16	1.29	1.21	0.90	0.72	0.63
0.050	1.00	1.10	1.19	1.34	1.06	0.79	0.64	0.56
0.051	1.00	1.10	1.20	1.35	1.06	0.79	0.64	0.56
0.060	1.00	1.12	1.22	1.22	0.95	0.72	0.59	0.52
0.070	1.00	1.13	1.25	1.11	0.87	0.66	0.54	0.48
0.080	1.00	1.15	1.27	1.02	0.80	0.61	0.51	0.45
0.090	1.00	1.16	1.30	0.95	0.75	0.57	0.48	0.43
0.100	1.00	1.17	1.32	0.89	0.70	0.54	0.45	0.41
0.107	1.00	1.18	1.33	0.85	0.67	0.52	0.44	0.40
0.150	1.00	1.23	1.07	0.68	0.54	0.42	0.36	0.33
0.200	1.00	1.27	0.88	0.55	0.44	0.35	0.30	0.28
0.240	1.00	1.29	0.76	0.48	0.38	0.30	0.26	0.24
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 14:24:42 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.02	1.05	1.10	1.14	1.21	1.29	1.36
0.010	1.00	1.02	1.05	1.10	1.14	1.21	1.29	1.34
0.013	1.00	1.03	1.07	1.12	1.17	1.26	1.36	1.16
0.020	1.00	1.05	1.09	1.17	1.24	1.36	1.08	0.92
0.020	1.00	1.05	1.10	1.18	1.24	1.35	1.07	0.91
0.030	1.00	1.07	1.13	1.24	1.33	1.07	0.85	0.73
0.033	1.00	1.08	1.15	1.26	1.36	1.01	0.81	0.70
0.040	1.00	1.09	1.17	1.30	1.23	0.91	0.73	0.63
0.050	1.00	1.11	1.20	1.35	1.07	0.80	0.65	0.57
0.051	1.00	1.11	1.20	1.36	1.06	0.79	0.64	0.56
0.060	1.00	1.12	1.23	1.23	0.96	0.72	0.59	0.52
0.070	1.00	1.14	1.26	1.12	0.88	0.66	0.55	0.49
0.080	1.00	1.15	1.28	1.03	0.81	0.62	0.51	0.46
0.090	1.00	1.17	1.30	0.96	0.76	0.58	0.48	0.43
0.100	1.00	1.18	1.32	0.90	0.71	0.54	0.46	0.41
0.107	1.00	1.19	1.34	0.86	0.68	0.52	0.44	0.40
0.150	1.00	1.23	1.08	0.69	0.55	0.43	0.37	0.34
0.200	1.00	1.27	0.88	0.56	0.45	0.35	0.31	0.28
0.242	1.00	1.30	0.76	0.48	0.38	0.30	0.26	0.24
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 14:24:48 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.50 max ti/R = 0.253

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.03	1.06	1.10	1.15	1.22	1.31	1.38
0.010	1.00	1.03	1.06	1.11	1.15	1.22	1.31	1.37
0.013	1.00	1.03	1.07	1.13	1.19	1.28	1.38	1.17
0.020	1.00	1.05	1.10	1.19	1.26	1.38	1.09	0.93
0.020	1.00	1.05	1.10	1.19	1.26	1.38	1.09	0.93
0.030	1.00	1.07	1.14	1.25	1.35	1.10	0.87	0.75
0.034	1.00	1.08	1.16	1.28	1.38	1.02	0.82	0.70
0.040	1.00	1.09	1.18	1.32	1.25	0.93	0.74	0.65
0.050	1.00	1.11	1.21	1.37	1.10	0.82	0.66	0.58
0.052	1.00	1.12	1.22	1.38	1.08	0.80	0.65	0.57
0.060	1.00	1.13	1.24	1.26	0.98	0.74	0.60	0.53
0.070	1.00	1.15	1.27	1.15	0.90	0.68	0.56	0.50
0.080	1.00	1.16	1.30	1.06	0.83	0.63	0.52	0.47
0.090	1.00	1.18	1.32	0.98	0.77	0.59	0.49	0.44
0.100	1.00	1.19	1.34	0.92	0.72	0.55	0.47	0.42
0.109	1.00	1.20	1.36	0.87	0.68	0.53	0.45	0.40
0.150	1.00	1.25	1.11	0.70	0.56	0.44	0.37	0.34
0.200	1.00	1.29	0.90	0.57	0.45	0.36	0.31	0.29
0.245	1.00	1.32	0.77	0.48	0.38	0.30	0.26	0.24
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Fri Dec 18 14:24:53 1992 1

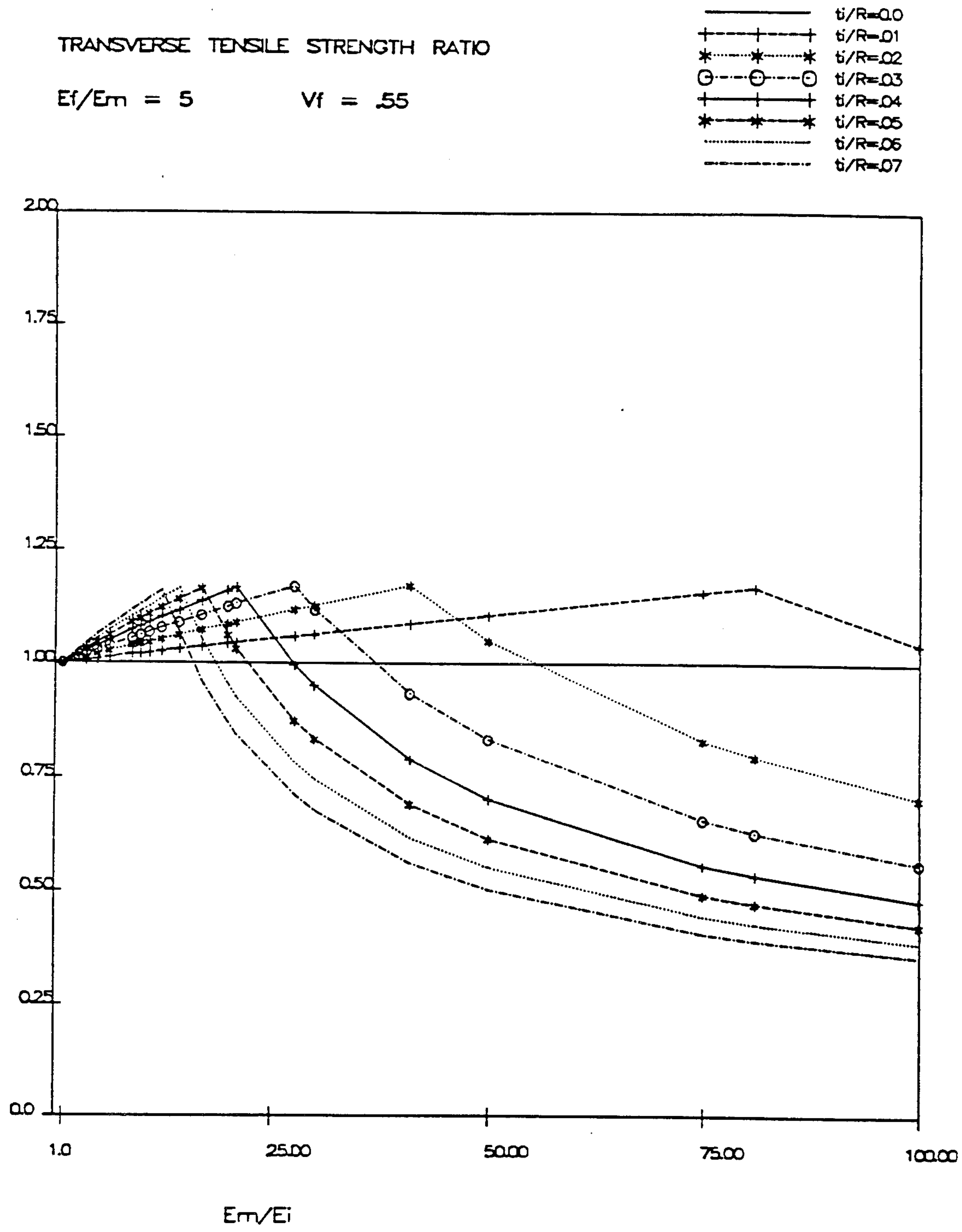
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

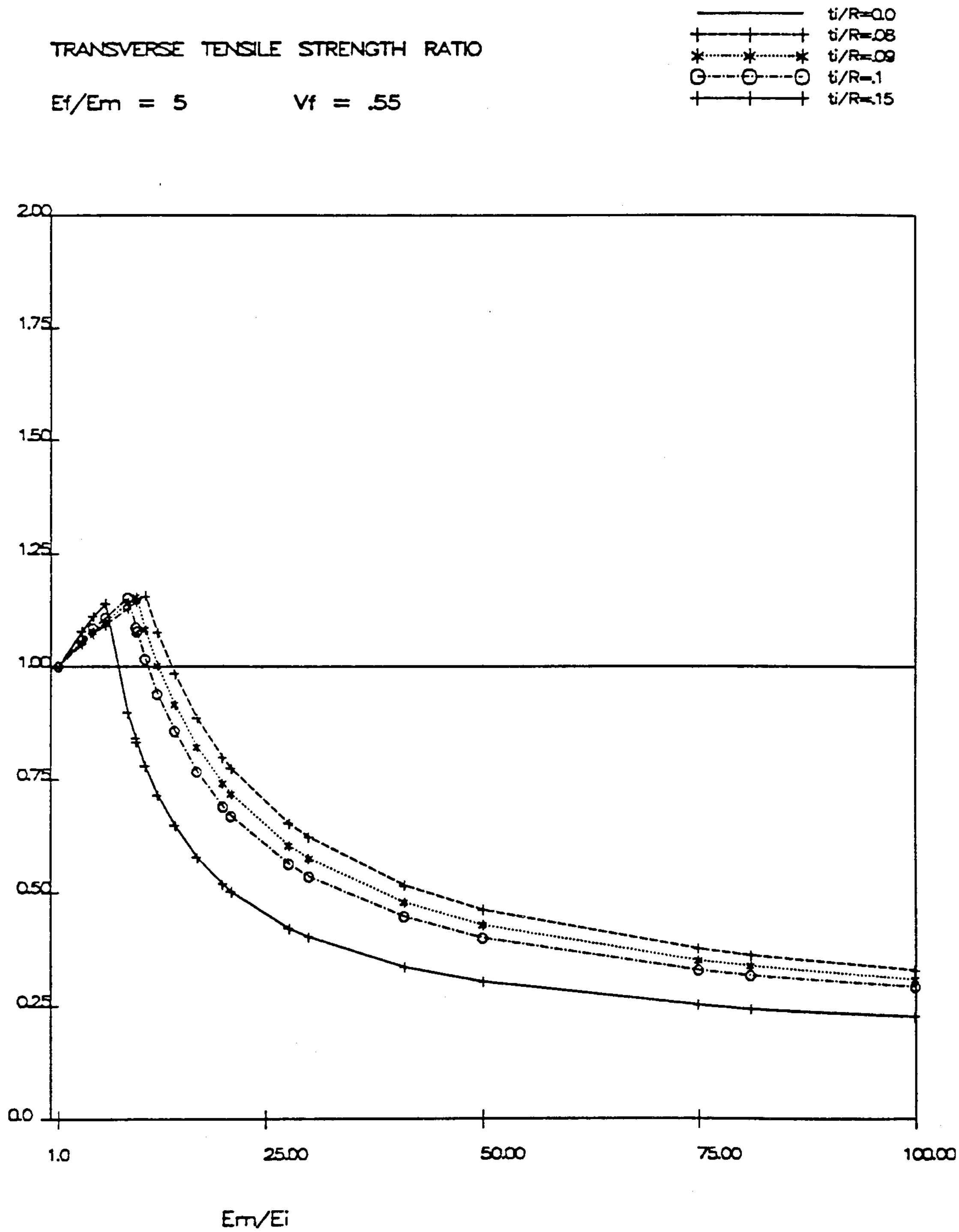
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

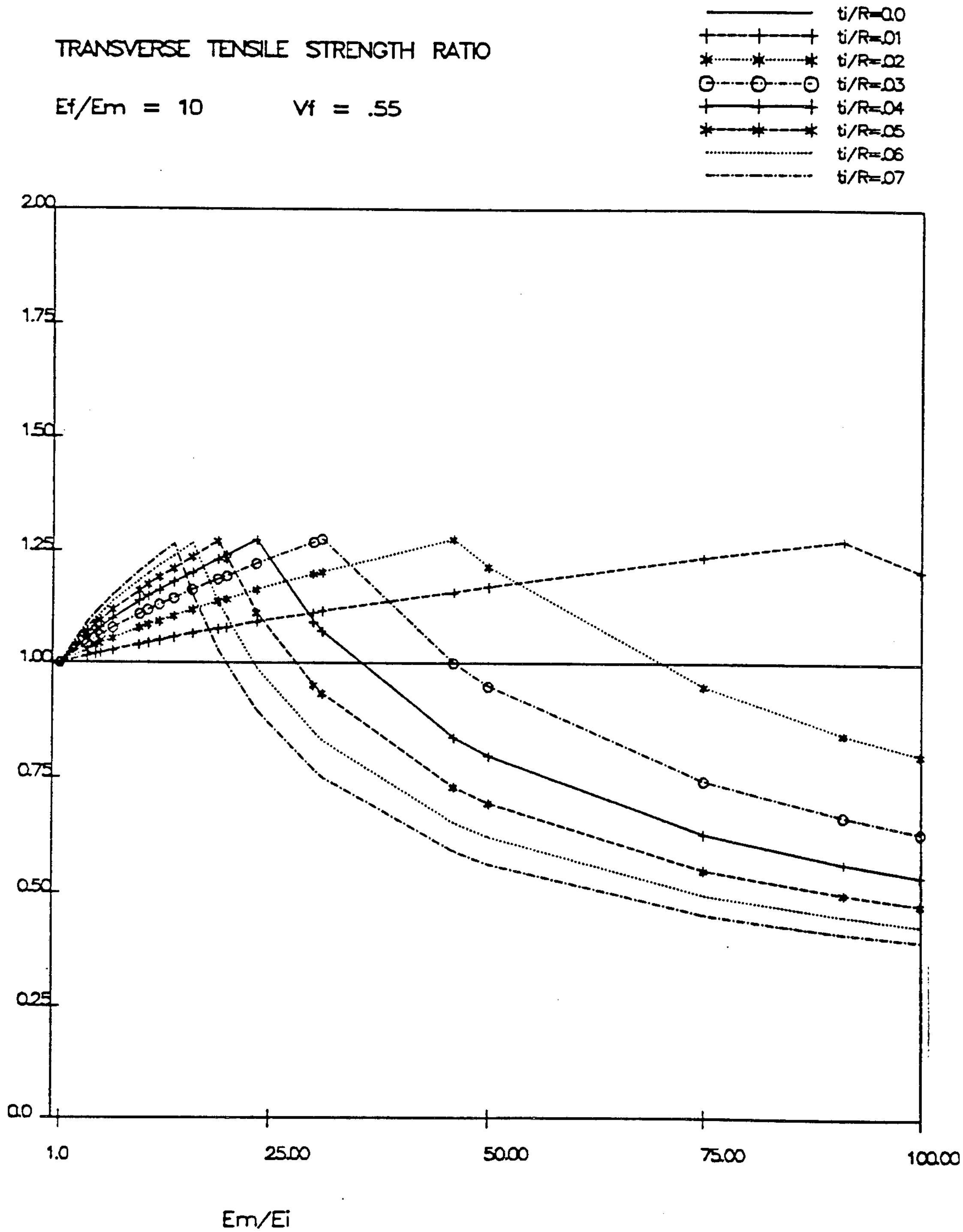
Ef / Em =100.0 Vf = 0.50 max ti/R = 0.253

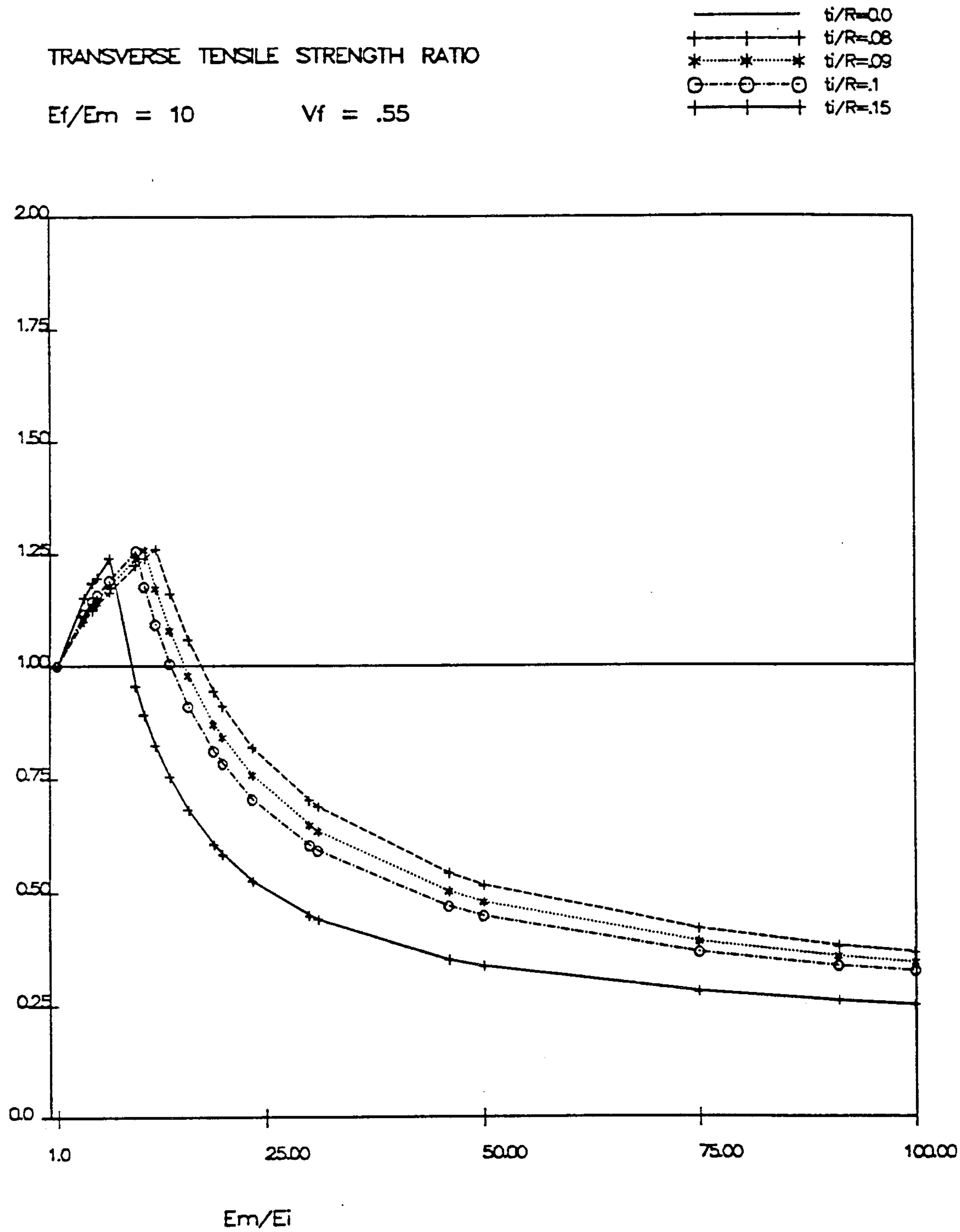
TRANSVERSE TENSILE STRENGTH RATIO

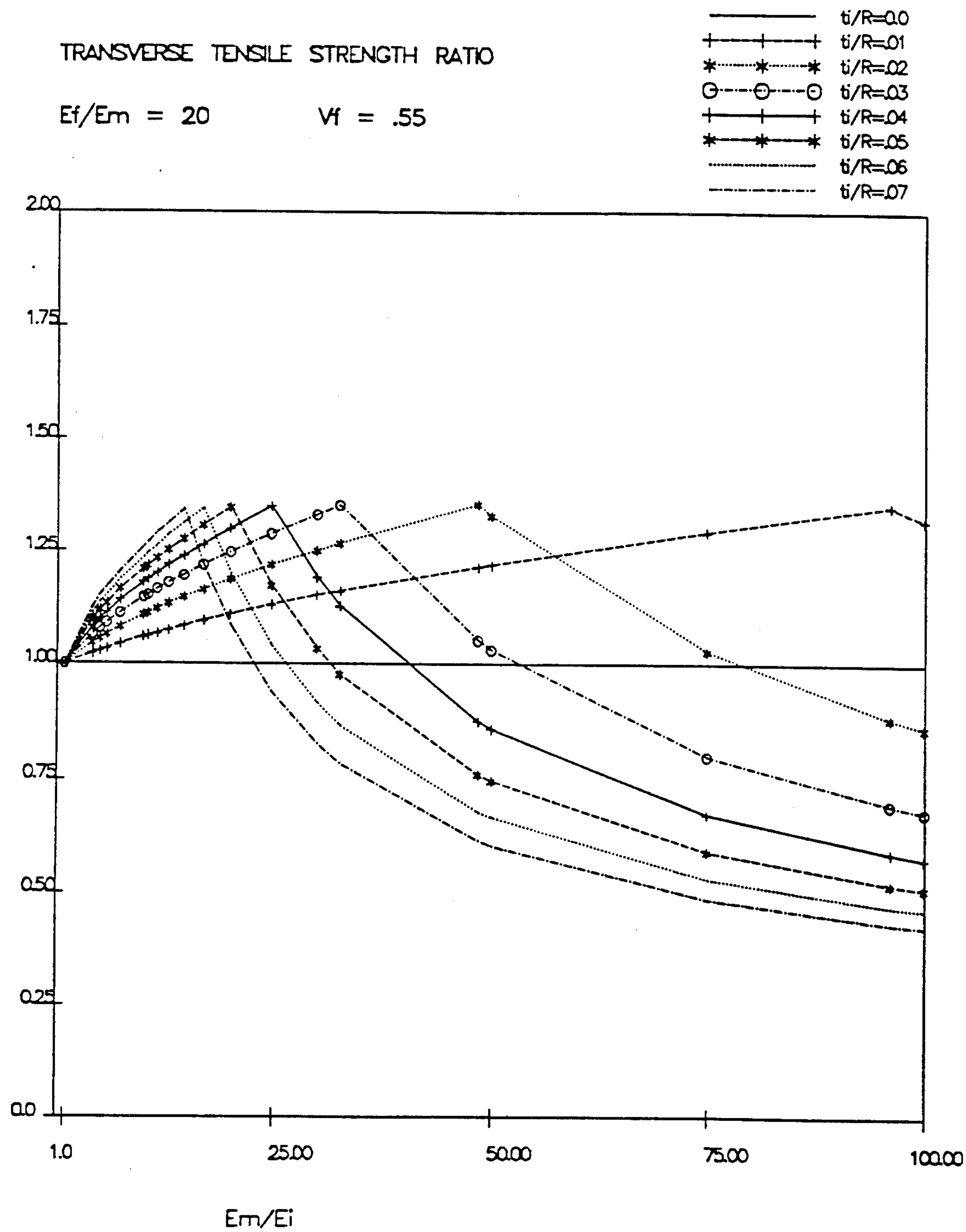
	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.03	1.06	1.11	1.16	1.23	1.32	1.40
0.010	1.00	1.03	1.06	1.11	1.16	1.23	1.32	1.40
0.013	1.00	1.04	1.08	1.14	1.20	1.29	1.40	1.19
0.020	1.00	1.05	1.11	1.20	1.27	1.40	1.11	0.95
0.020	1.00	1.06	1.11	1.20	1.27	1.40	1.11	0.94
0.030	1.00	1.08	1.15	1.27	1.36	1.12	0.88	0.76
0.034	1.00	1.09	1.17	1.29	1.40	1.03	0.82	0.71
0.040	1.00	1.10	1.19	1.33	1.28	0.94	0.76	0.66
0.050	1.00	1.12	1.22	1.38	1.12	0.83	0.67	0.59
0.052	1.00	1.12	1.23	1.40	1.09	0.81	0.66	0.58
0.060	1.00	1.14	1.25	1.28	1.00	0.75	0.61	0.54
0.070	1.00	1.16	1.28	1.17	0.91	0.69	0.57	0.50
0.080	1.00	1.17	1.31	1.07	0.84	0.64	0.53	0.47
0.090	1.00	1.19	1.33	1.00	0.78	0.60	0.50	0.45
0.100	1.00	1.20	1.36	0.93	0.73	0.56	0.47	0.43
0.110	1.00	1.21	1.38	0.88	0.69	0.53	0.45	0.41
0.150	1.00	1.26	1.13	0.71	0.57	0.44	0.38	0.35
0.200	1.00	1.30	0.92	0.58	0.46	0.36	0.31	0.29
0.248	1.00	1.33	0.78	0.49	0.39	0.31	0.26	0.24
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010

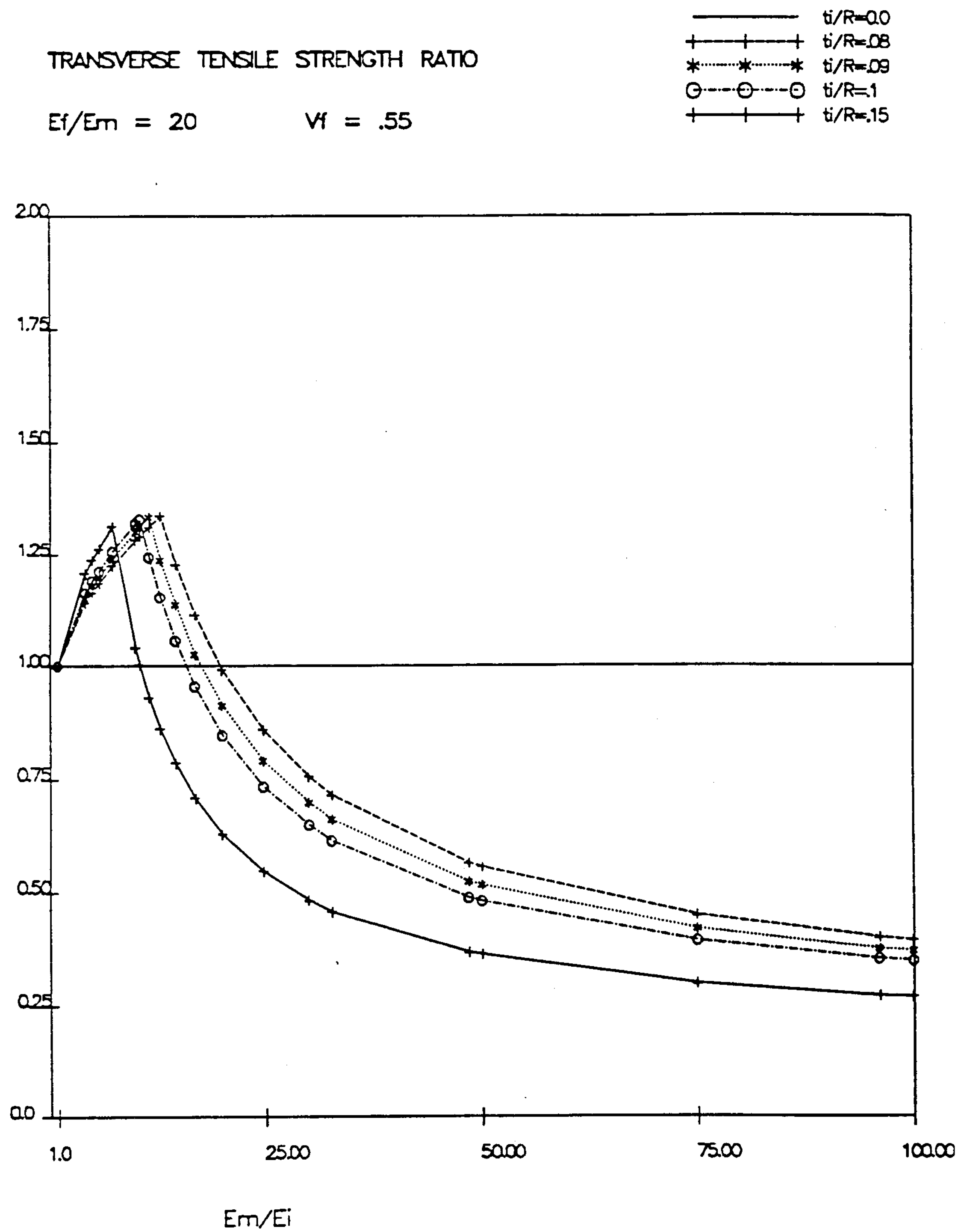

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

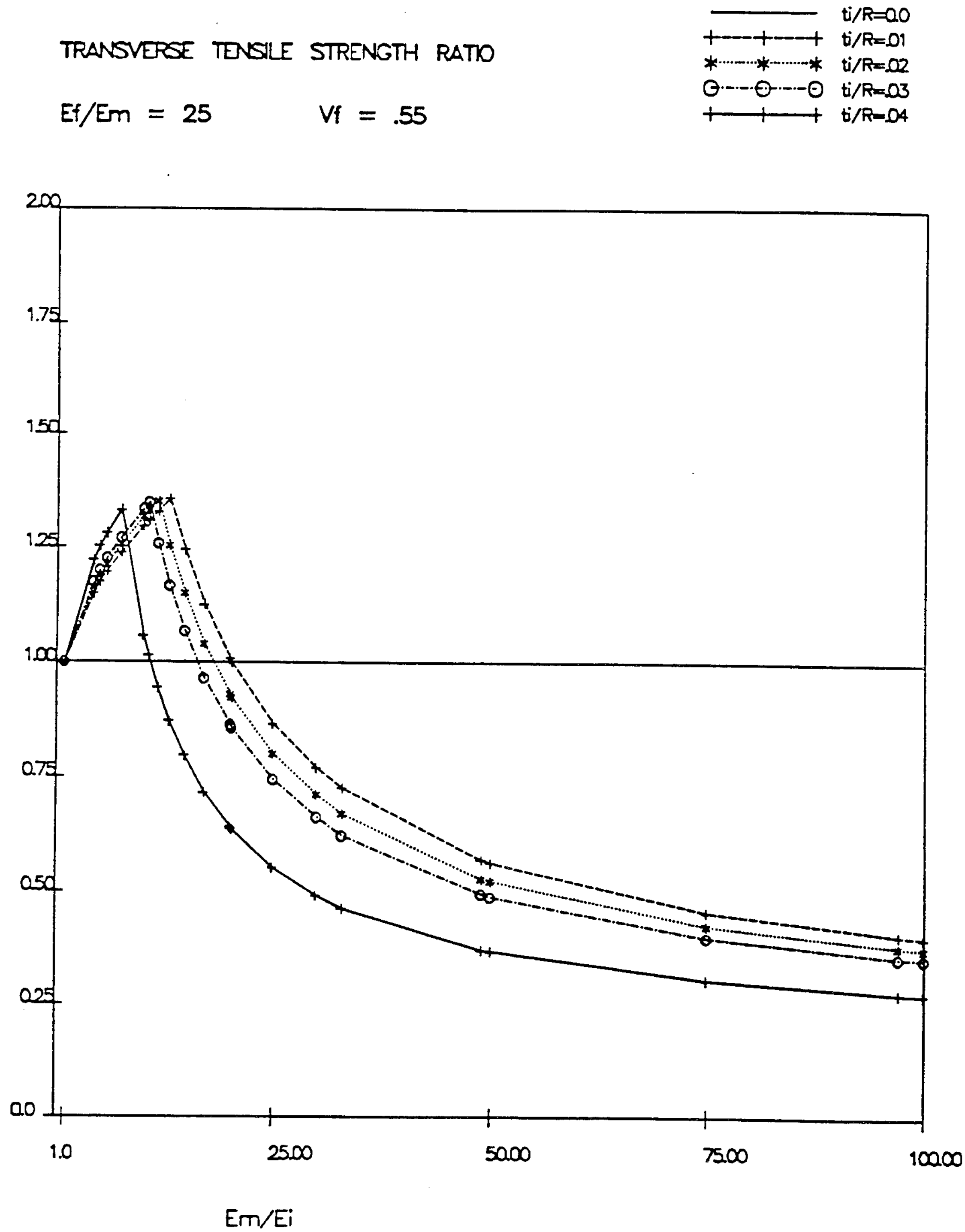

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5 Vf = .55
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10 Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

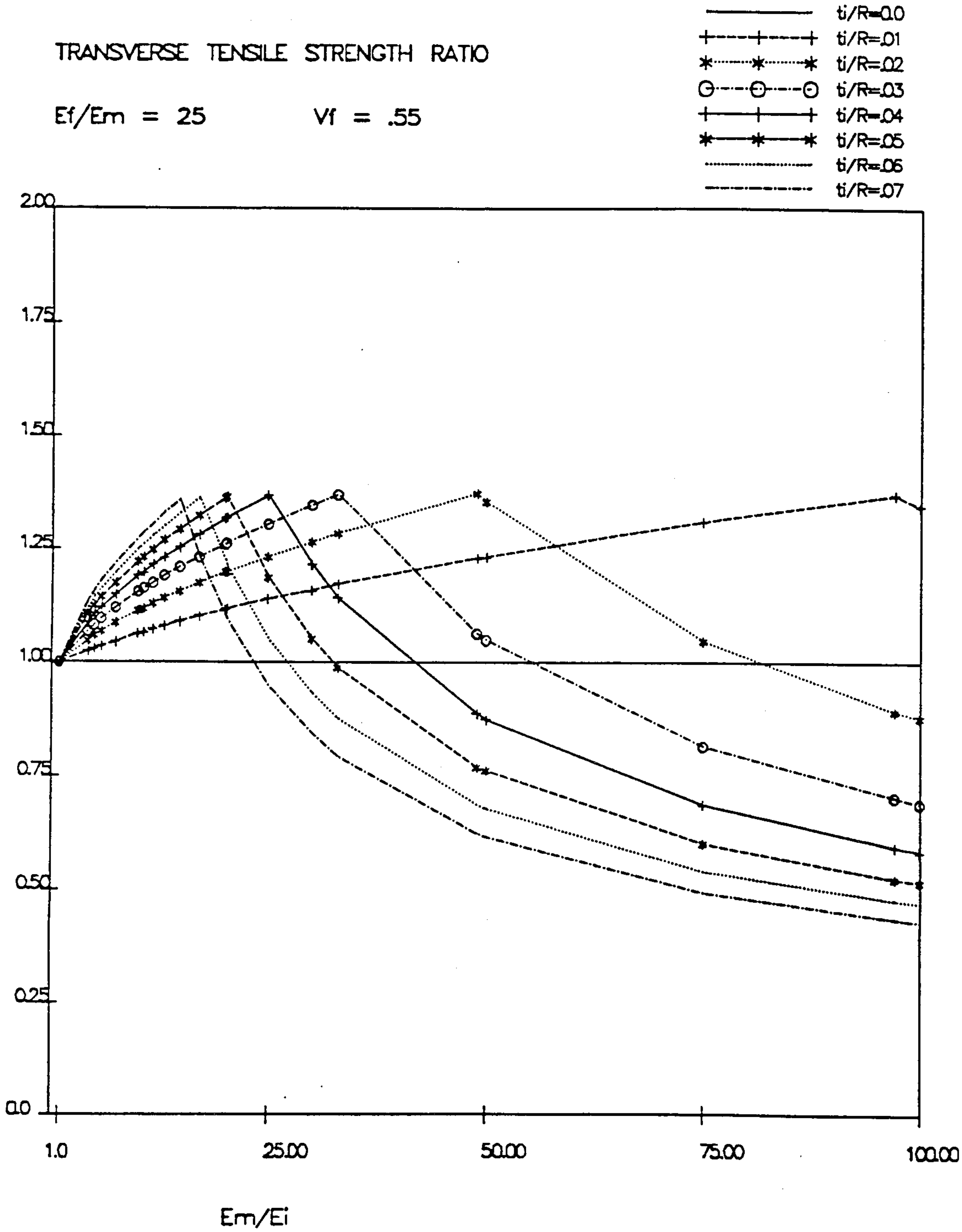

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .55
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

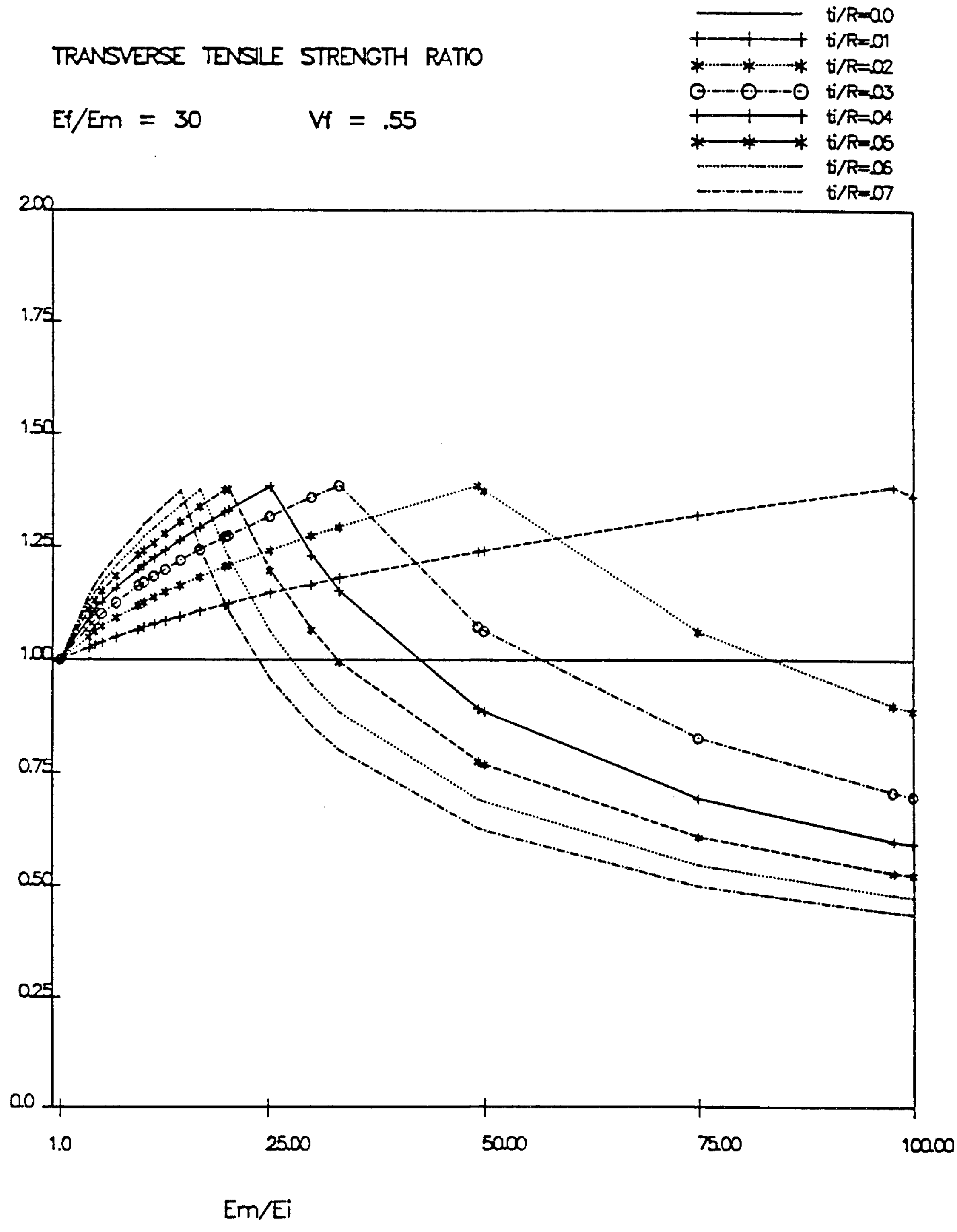

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .55
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

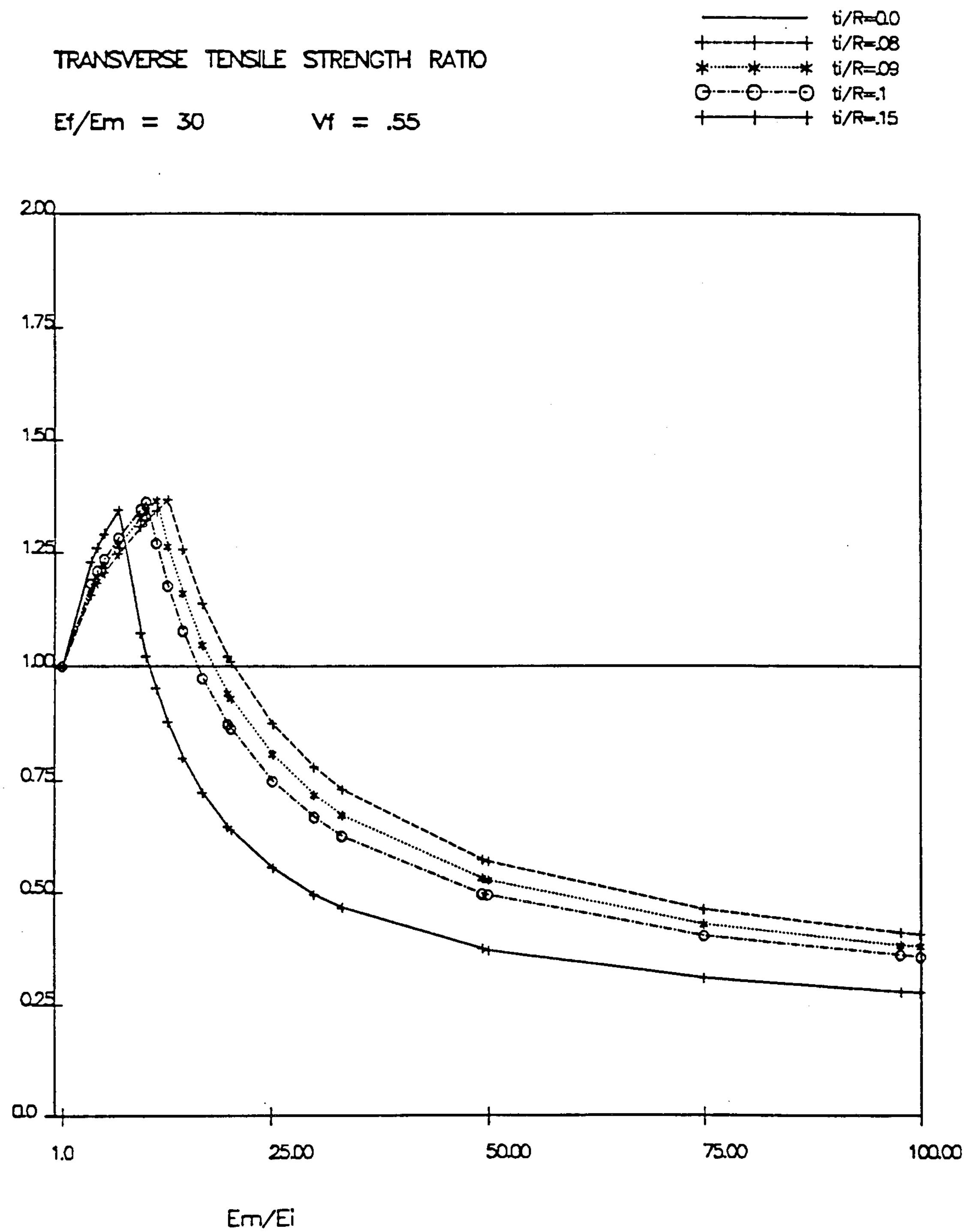


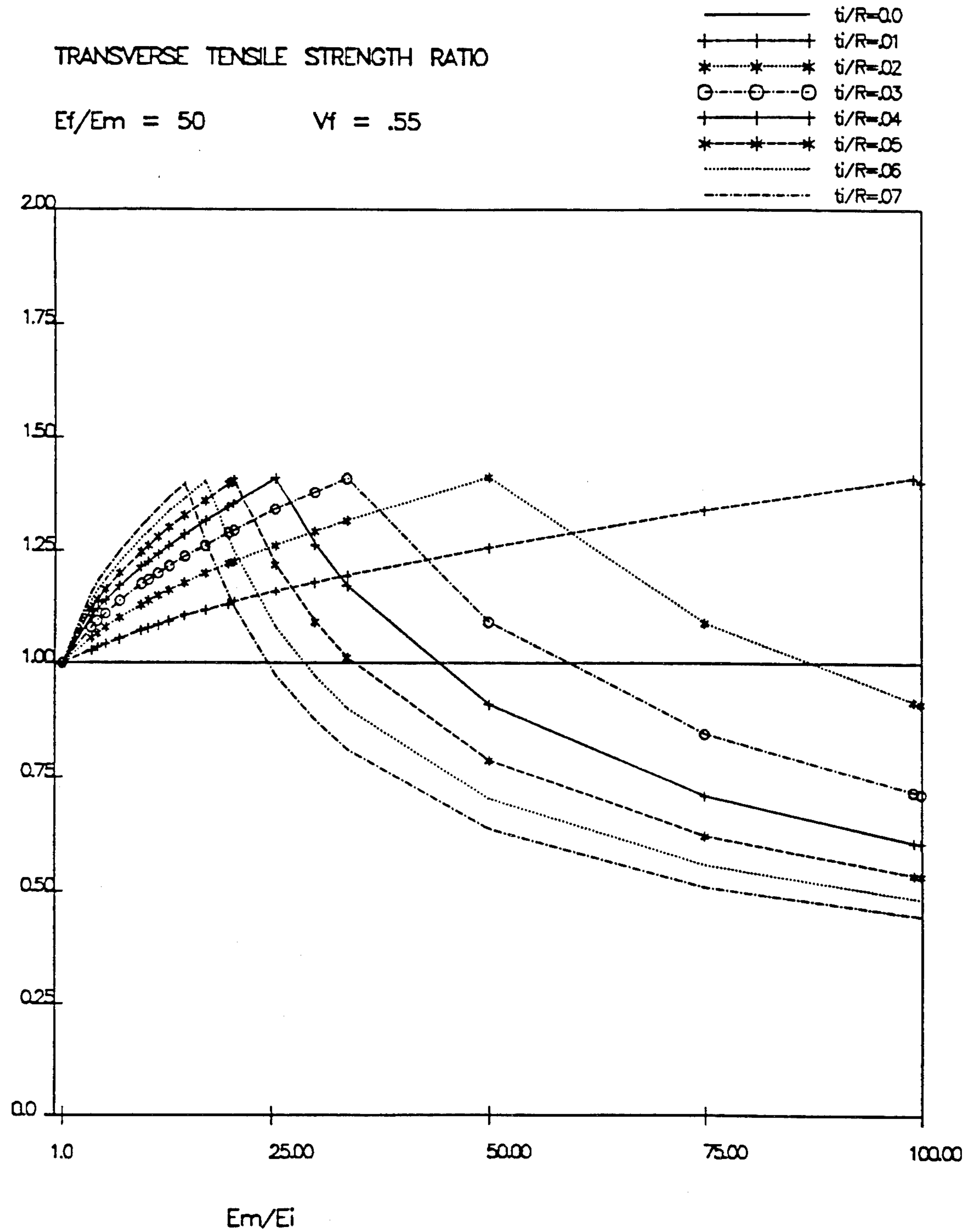
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

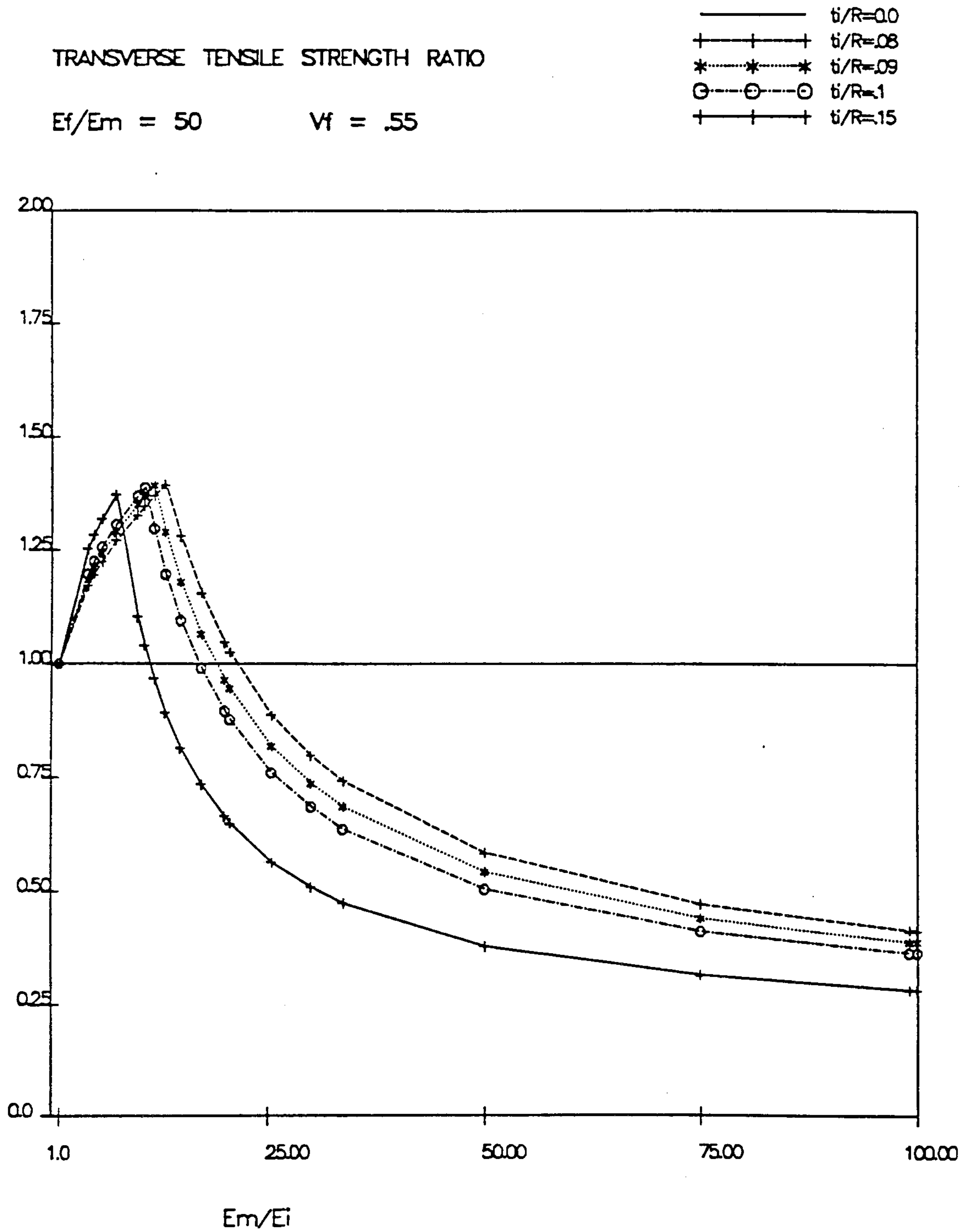

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

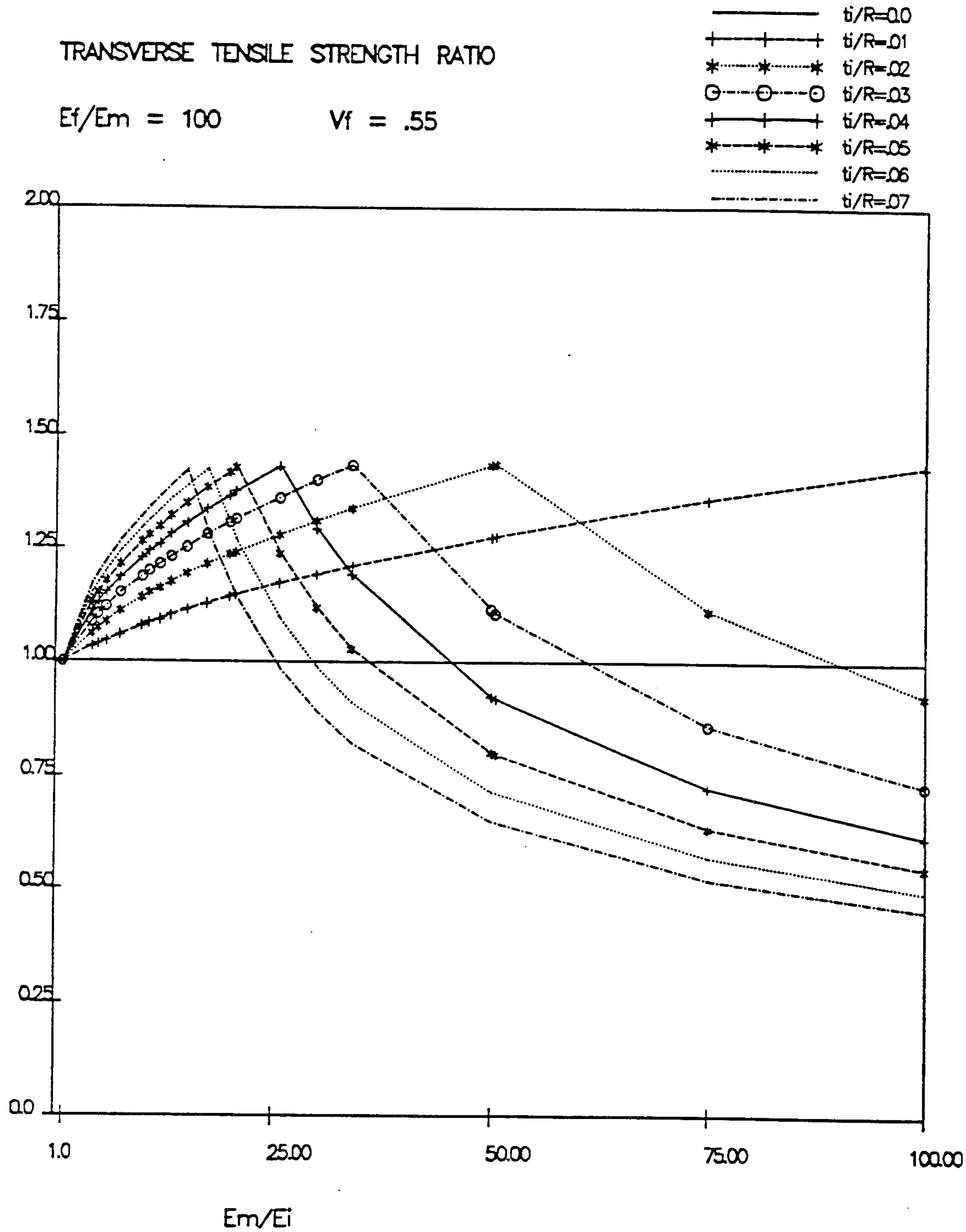


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .55
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50 Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

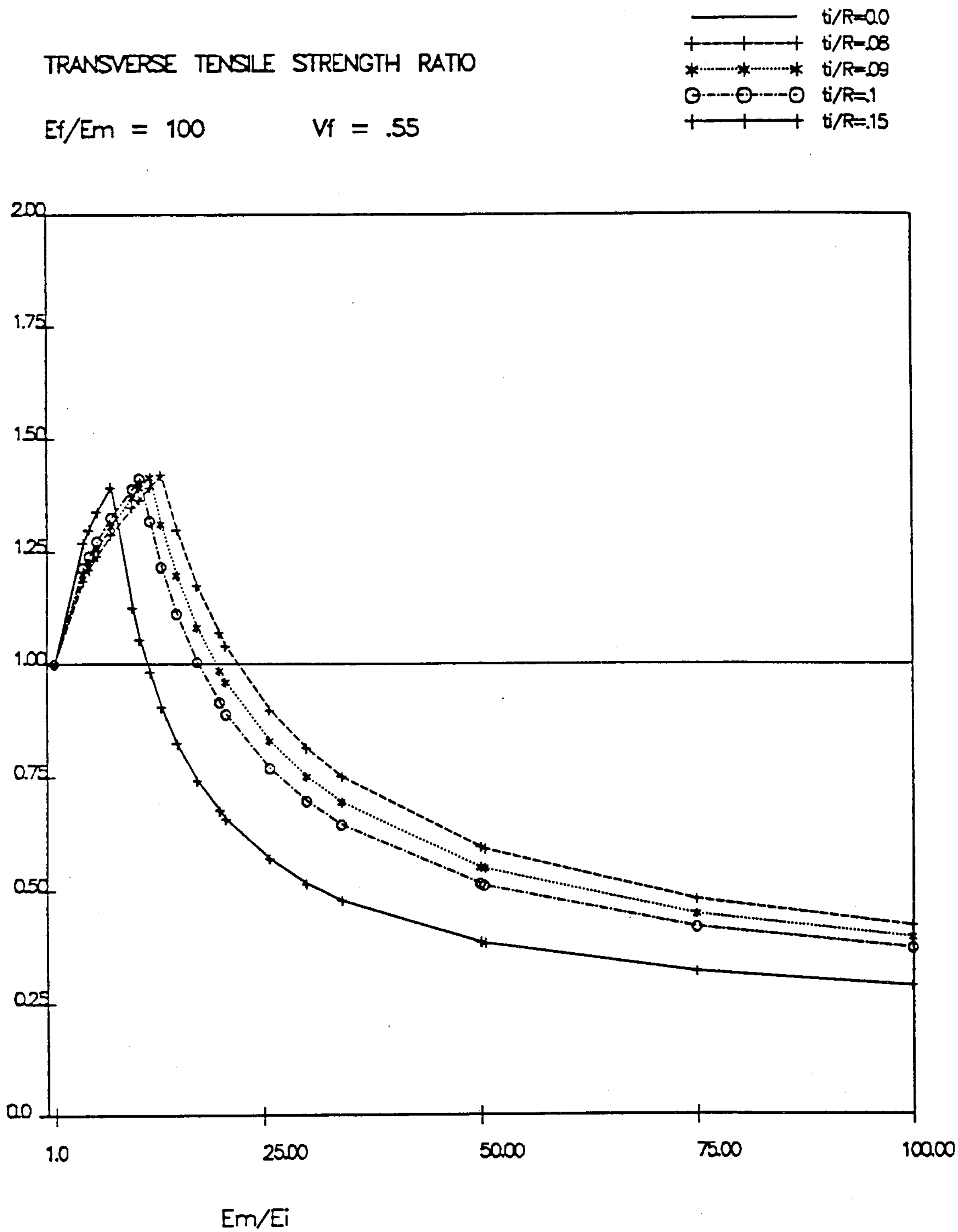

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .55
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
ti/R=.15
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .55
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

TRANSVERSE TENSILE STRENGTH RATIO

Ef/Em = 100 Vf = .55



tratout Thu Dec 17 14:44:04 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.7	1.00	1.01	1.01	1.02	1.03	1.03	1.04	1.04
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.06
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.06
6.3	1.00	1.01	1.03	1.04	1.05	1.06	1.07	1.08
9.0	1.00	1.02	1.04	1.06	1.07	1.09	1.10	1.12
9.9	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.13
10.0	1.00	1.02	1.04	1.06	1.08	1.10	1.12	1.13
11.0	1.00	1.02	1.05	1.07	1.09	1.11	1.13	1.14
12.4	1.00	1.03	1.05	1.08	1.10	1.12	1.14	1.16
14.3	1.00	1.03	1.06	1.09	1.12	1.14	1.16	1.07
17.0	1.00	1.04	1.07	1.11	1.14	1.17	1.05	0.96
20.0	1.00	1.04	1.09	1.13	1.16	1.06	0.95	0.87
21.0	1.00	1.05	1.09	1.13	1.17	1.03	0.93	0.84
27.7	1.00	1.06	1.12	1.17	1.00	0.87	0.78	0.71
30.0	1.00	1.07	1.13	1.12	0.95	0.83	0.74	0.68
41.0	1.00	1.09	1.17	0.94	0.79	0.69	0.62	0.56
50.0	1.00	1.11	1.05	0.83	0.70	0.61	0.55	0.50
75.0	1.00	1.16	0.83	0.66	0.56	0.49	0.44	0.41
81.0	1.00	1.17	0.80	0.63	0.53	0.47	0.43	0.39
100.0	1.00	1.04	0.71	0.56	0.48	0.42	0.39	0.36
Em/Ei cr		81.00	41.00	27.67	21.00	17.00	14.33	12.43

Em/Ei	ti / R = 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
3.7	1.05	1.05	1.06	1.08
5.0	1.07	1.08	1.09	1.11
5.0	1.07	1.08	1.09	1.11
6.3	1.09	1.10	1.11	1.14
9.0	1.13	1.14	1.15	0.90
9.9	1.14	1.16	1.09	0.84
10.0	1.15	1.15	1.08	0.83
11.0	1.16	1.08	1.02	0.78
12.4	1.08	1.00	0.94	0.72
14.3	0.99	0.92	0.86	0.65
17.0	0.89	0.82	0.77	0.58
20.0	0.80	0.74	0.69	0.52
21.0	0.78	0.72	0.67	0.50
27.7	0.65	0.60	0.56	0.42
30.0	0.62	0.58	0.54	0.40
41.0	0.52	0.48	0.45	0.34
50.0	0.46	0.43	0.40	0.30
75.0	0.38	0.35	0.33	0.25
81.0	0.36	0.34	0.32	0.24
100.0	0.33	0.31	0.29	0.23
Em/Ei cr	11.00	9.89	9.00	6.33

tratout   Thu Dec 17 14:44:09 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0   Vf = 0.55   max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.0	1.00	1.02	1.03	1.04	1.06	1.07	1.08	1.09
5.0	1.00	1.02	1.04	1.06	1.07	1.09	1.10	1.11
5.5	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.12
7.0	1.00	1.03	1.06	1.08	1.10	1.12	1.14	1.15
10.0	1.00	1.04	1.08	1.11	1.14	1.16	1.18	1.21
10.0	1.00	1.04	1.08	1.11	1.14	1.16	1.18	1.21
11.0	1.00	1.05	1.09	1.12	1.15	1.18	1.20	1.22
12.2	1.00	1.05	1.09	1.13	1.16	1.19	1.22	1.24
13.9	1.00	1.06	1.11	1.14	1.18	1.21	1.24	1.27
16.0	1.00	1.07	1.12	1.16	1.20	1.24	1.27	1.15
19.0	1.00	1.08	1.14	1.19	1.23	1.27	1.14	1.03
20.0	1.00	1.08	1.14	1.20	1.24	1.23	1.10	1.00
23.5	1.00	1.09	1.16	1.22	1.27	1.11	0.99	0.90
30.0	1.00	1.11	1.20	1.27	1.09	0.95	0.85	0.77
31.0	1.00	1.12	1.20	1.28	1.07	0.93	0.83	0.75
46.0	1.00	1.16	1.28	1.00	0.84	0.73	0.65	0.59
50.0	1.00	1.17	1.21	0.95	0.80	0.69	0.62	0.56
75.0	1.00	1.24	0.95	0.74	0.63	0.55	0.49	0.45
91.0	1.00	1.27	0.84	0.66	0.56	0.50	0.45	0.41
100.0	1.00	1.21	0.80	0.63	0.54	0.47	0.43	0.40
Em/Ei cr		91.00	46.00	31.00	23.50	19.00	16.00	13.86

Em/Ei	ti / R 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.0	1.10	1.11	1.12	1.15
5.0	1.12	1.13	1.14	1.19
5.5	1.14	1.15	1.16	1.20
7.0	1.17	1.18	1.19	1.24
10.0	1.22	1.24	1.26	0.96
10.0	1.22	1.24	1.26	0.96
11.0	1.24	1.26	1.18	0.89
12.2	1.26	1.17	1.09	0.82
13.9	1.16	1.08	1.01	0.75
16.0	1.06	0.98	0.91	0.68
19.0	0.94	0.87	0.81	0.60
20.0	0.91	0.84	0.78	0.58
23.5	0.82	0.76	0.71	0.52
30.0	0.70	0.65	0.60	0.45
31.0	0.69	0.63	0.59	0.44
46.0	0.54	0.50	0.47	0.35
50.0	0.52	0.48	0.45	0.34
75.0	0.42	0.39	0.37	0.28
91.0	0.38	0.36	0.34	0.26
100.0	0.37	0.34	0.32	0.25
Em/Ei cr	12.25	11.00	10.00	7.00

tratout Thu Dec 17 14:44:14 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.02	1.04	1.06	1.08	1.10	1.11	1.13
5.0	1.00	1.03	1.05	1.08	1.10	1.12	1.13	1.15
5.8	1.00	1.03	1.06	1.09	1.11	1.13	1.15	1.17
7.3	1.00	1.04	1.08	1.11	1.14	1.16	1.19	1.21
10.0	1.00	1.06	1.11	1.15	1.18	1.21	1.24	1.26
10.5	1.00	1.06	1.11	1.15	1.19	1.22	1.25	1.27
11.6	1.00	1.07	1.12	1.16	1.20	1.23	1.26	1.29
12.9	1.00	1.07	1.13	1.18	1.22	1.25	1.28	1.31
14.6	1.00	1.08	1.15	1.20	1.24	1.28	1.31	1.34
16.8	1.00	1.09	1.16	1.22	1.27	1.31	1.34	1.22
20.0	1.00	1.11	1.19	1.25	1.30	1.35	1.20	1.08
20.0	1.00	1.11	1.19	1.25	1.30	1.35	1.20	1.08
24.8	1.00	1.13	1.22	1.29	1.35	1.17	1.04	0.94
30.0	1.00	1.15	1.25	1.33	1.19	1.03	0.92	0.83
32.7	1.00	1.16	1.27	1.35	1.13	0.98	0.87	0.78
48.5	1.00	1.22	1.35	1.05	0.88	0.76	0.68	0.62
50.0	1.00	1.22	1.33	1.03	0.86	0.75	0.67	0.60
75.0	1.00	1.29	1.03	0.80	0.67	0.59	0.53	0.49
96.0	1.00	1.35	0.88	0.69	0.59	0.52	0.47	0.43
100.0	1.00	1.32	0.86	0.68	0.58	0.51	0.46	0.42
Em/Ei cr		96.00	48.50	32.67	24.75	20.00	16.83	14.57

Em/Ei	ti / R 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.2	1.14	1.15	1.16	1.21
5.0	1.17	1.18	1.19	1.24
5.8	1.19	1.20	1.21	1.27
7.3	1.23	1.24	1.26	1.32
10.0	1.28	1.30	1.32	1.04
10.5	1.29	1.31	1.33	1.00
11.6	1.31	1.34	1.25	0.93
12.9	1.34	1.24	1.15	0.86
14.6	1.23	1.14	1.06	0.79
16.8	1.11	1.03	0.96	0.71
20.0	0.99	0.91	0.85	0.63
20.0	0.99	0.91	0.85	0.63
24.8	0.86	0.79	0.74	0.55
30.0	0.76	0.70	0.65	0.48
32.7	0.72	0.66	0.62	0.46
48.5	0.56	0.52	0.49	0.37
50.0	0.56	0.51	0.48	0.36
75.0	0.45	0.42	0.39	0.30
96.0	0.40	0.38	0.35	0.27
100.0	0.39	0.37	0.35	0.27
Em/Ei cr	12.88	11.56	10.50	7.33

tratout Thu Dec 17 14:44:19 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.03	1.05	1.07	1.09	1.11	1.12	1.14
5.0	1.00	1.03	1.06	1.08	1.11	1.13	1.14	1.16
5.8	1.00	1.04	1.07	1.10	1.12	1.14	1.16	1.18
7.4	1.00	1.05	1.09	1.12	1.15	1.18	1.20	1.22
10.0	1.00	1.06	1.11	1.16	1.19	1.22	1.25	1.27
10.6	1.00	1.07	1.12	1.16	1.20	1.23	1.26	1.29
11.7	1.00	1.07	1.13	1.18	1.21	1.25	1.28	1.31
13.0	1.00	1.08	1.14	1.19	1.23	1.27	1.30	1.33
14.7	1.00	1.09	1.16	1.21	1.25	1.29	1.33	1.36
17.0	1.00	1.10	1.18	1.23	1.28	1.32	1.36	1.23
20.0	1.00	1.12	1.20	1.26	1.32	1.36	1.22	1.10
20.2	1.00	1.12	1.20	1.26	1.32	1.37	1.21	1.10
25.0	1.00	1.14	1.23	1.31	1.37	1.19	1.05	0.95
30.0	1.00	1.16	1.26	1.35	1.22	1.05	0.93	0.84
33.0	1.00	1.17	1.28	1.37	1.14	0.99	0.88	0.79
49.0	1.00	1.23	1.37	1.06	0.89	0.77	0.69	0.62
50.0	1.00	1.23	1.36	1.05	0.88	0.76	0.68	0.61
75.0	1.00	1.31	1.05	0.82	0.69	0.60	0.54	0.49
97.0	1.00	1.37	0.89	0.70	0.59	0.52	0.47	0.44
100.0	1.00	1.34	0.88	0.69	0.58	0.52	0.47	0.43
Em/Ei cr		97.00	49.00	33.00	25.00	20.20	17.00	14.71

Em/Ei	ti / R = 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.2	1.15	1.16	1.17	1.22
5.0	1.18	1.19	1.20	1.25
5.8	1.20	1.21	1.23	1.28
7.4	1.24	1.26	1.27	1.33
10.0	1.30	1.32	1.34	1.06
10.6	1.31	1.33	1.35	1.01
11.7	1.33	1.35	1.26	0.94
13.0	1.36	1.25	1.17	0.87
14.7	1.25	1.15	1.07	0.80
17.0	1.13	1.04	0.97	0.72
20.0	1.01	0.93	0.86	0.64
20.2	1.00	0.92	0.86	0.64
25.0	0.87	0.80	0.74	0.55
30.0	0.77	0.71	0.66	0.49
33.0	0.72	0.67	0.62	0.46
49.0	0.57	0.53	0.49	0.37
50.0	0.56	0.52	0.49	0.37
75.0	0.46	0.43	0.40	0.30
97.0	0.41	0.38	0.36	0.28
100.0	0.40	0.37	0.35	0.27
Em/Ei cr	13.00	11.67	10.60	7.40

tratout **Thu Dec 17 14:44:24 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.03	1.05	1.07	1.09	1.11	1.13	1.14
5.0	1.00	1.03	1.06	1.09	1.11	1.13	1.15	1.17
5.8	1.00	1.04	1.07	1.10	1.13	1.15	1.17	1.19
7.4	1.00	1.05	1.09	1.13	1.16	1.18	1.21	1.23
10.0	1.00	1.07	1.12	1.16	1.20	1.23	1.26	1.28
10.7	1.00	1.07	1.13	1.17	1.21	1.24	1.27	1.30
11.7	1.00	1.08	1.14	1.18	1.22	1.26	1.29	1.32
13.1	1.00	1.09	1.15	1.20	1.24	1.28	1.31	1.34
14.8	1.00	1.10	1.16	1.22	1.26	1.30	1.34	1.37
17.1	1.00	1.11	1.18	1.24	1.29	1.34	1.38	1.24
20.0	1.00	1.12	1.21	1.27	1.33	1.37	1.24	1.12
20.3	1.00	1.12	1.21	1.27	1.33	1.38	1.23	1.11
25.2	1.00	1.15	1.24	1.32	1.38	1.20	1.06	0.96
30.0	1.00	1.17	1.27	1.36	1.23	1.07	0.95	0.85
33.2	1.00	1.18	1.29	1.38	1.15	1.00	0.88	0.80
49.3	1.00	1.24	1.39	1.07	0.89	0.78	0.69	0.63
50.0	1.00	1.24	1.37	1.06	0.89	0.77	0.69	0.62
75.0	1.00	1.32	1.06	0.83	0.69	0.61	0.55	0.50
97.7	1.00	1.38	0.90	0.71	0.60	0.53	0.48	0.44
100.0	1.00	1.36	0.89	0.70	0.59	0.52	0.47	0.44
Em/Ei cr		97.67	49.33	33.22	25.17	20.33	17.11	14.81

Em/Ei	ti / R 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.2	1.16	1.17	1.18	1.23
5.0	1.18	1.20	1.21	1.26
5.8	1.21	1.22	1.24	1.29
7.4	1.25	1.27	1.28	1.35
10.0	1.31	1.33	1.35	1.07
10.7	1.32	1.34	1.36	1.02
11.7	1.34	1.37	1.27	0.95
13.1	1.37	1.27	1.18	0.88
14.8	1.26	1.16	1.08	0.80
17.1	1.14	1.05	0.97	0.72
20.0	1.02	0.94	0.87	0.65
20.3	1.01	0.93	0.86	0.64
25.2	0.87	0.81	0.75	0.55
30.0	0.78	0.72	0.67	0.50
33.2	0.73	0.67	0.63	0.47
49.3	0.58	0.53	0.50	0.37
50.0	0.57	0.53	0.49	0.37
75.0	0.46	0.43	0.40	0.31
97.7	0.41	0.38	0.36	0.28
100.0	0.40	0.38	0.36	0.28
Em/Ei cr	13.08	11.74	10.67	7.44

tratout Thu Dec 17 14:44:31 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.03	1.06	1.08	1.10	1.12	1.14	1.16
5.0	1.00	1.04	1.07	1.10	1.12	1.14	1.16	1.18
5.9	1.00	1.04	1.08	1.11	1.14	1.17	1.19	1.21
7.5	1.00	1.06	1.10	1.14	1.17	1.20	1.23	1.25
10.0	1.00	1.07	1.13	1.18	1.22	1.25	1.28	1.31
10.8	1.00	1.08	1.14	1.19	1.23	1.26	1.29	1.32
11.9	1.00	1.09	1.15	1.20	1.24	1.28	1.31	1.34
13.3	1.00	1.10	1.16	1.22	1.26	1.30	1.34	1.37
15.0	1.00	1.11	1.18	1.24	1.29	1.33	1.37	1.40
17.3	1.00	1.12	1.20	1.26	1.32	1.36	1.40	1.27
20.0	1.00	1.13	1.22	1.29	1.35	1.40	1.27	1.15
20.6	1.00	1.14	1.23	1.30	1.36	1.41	1.25	1.13
25.5	1.00	1.16	1.26	1.34	1.41	1.22	1.08	0.97
30.0	1.00	1.18	1.29	1.38	1.27	1.09	0.97	0.87
33.7	1.00	1.20	1.32	1.41	1.17	1.01	0.90	0.81
50.0	1.00	1.26	1.41	1.09	0.91	0.79	0.70	0.64
50.0	1.00	1.26	1.41	1.09	0.91	0.79	0.70	0.64
75.0	1.00	1.34	1.09	0.85	0.71	0.62	0.56	0.51
99.0	1.00	1.41	0.92	0.72	0.61	0.54	0.49	0.45
100.0	1.00	1.40	0.91	0.71	0.61	0.53	0.48	0.45
Em/Ei cr		99.00	50.00	33.67	25.50	20.60	17.33	15.00

Em/Ei	ti / R = 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.3	1.17	1.19	1.20	1.25
5.0	1.20	1.21	1.23	1.28
5.9	1.23	1.24	1.26	1.32
7.5	1.27	1.29	1.31	1.37
10.0	1.33	1.35	1.37	1.10
10.8	1.35	1.37	1.39	1.04
11.9	1.37	1.39	1.30	0.97
13.3	1.40	1.29	1.20	0.89
15.0	1.28	1.18	1.10	0.81
17.3	1.16	1.07	0.99	0.73
20.0	1.05	0.97	0.90	0.66
20.6	1.03	0.95	0.88	0.65
25.5	0.89	0.82	0.76	0.56
30.0	0.80	0.74	0.68	0.51
33.7	0.74	0.68	0.64	0.47
50.0	0.58	0.54	0.51	0.38
50.0	0.58	0.54	0.51	0.38
75.0	0.47	0.44	0.41	0.31
99.0	0.42	0.39	0.37	0.28
100.0	0.41	0.39	0.37	0.28
Em/Ei cr	13.25	11.89	10.80	7.53

tratout Thu Dec 17 14:44:36 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

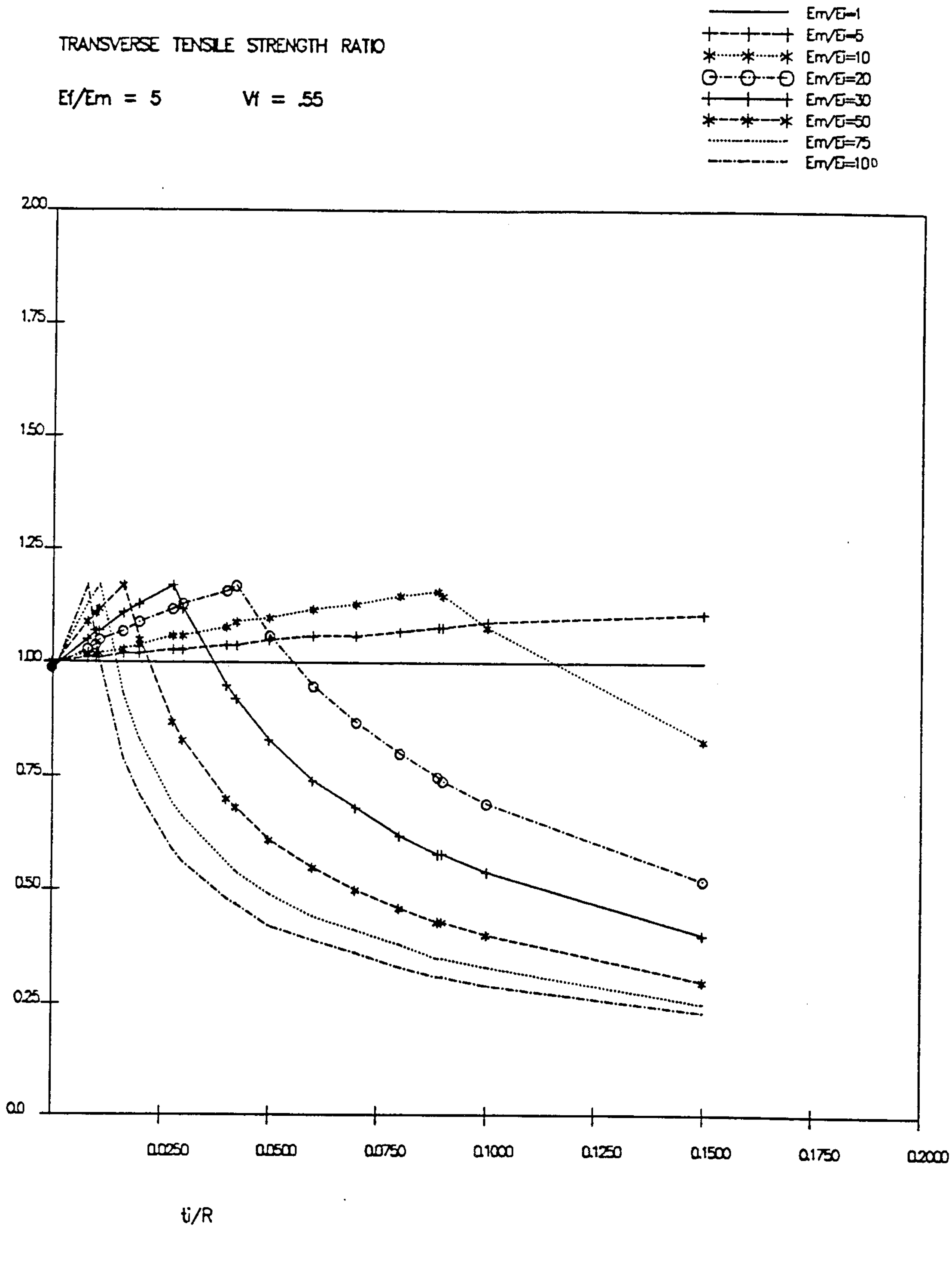
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

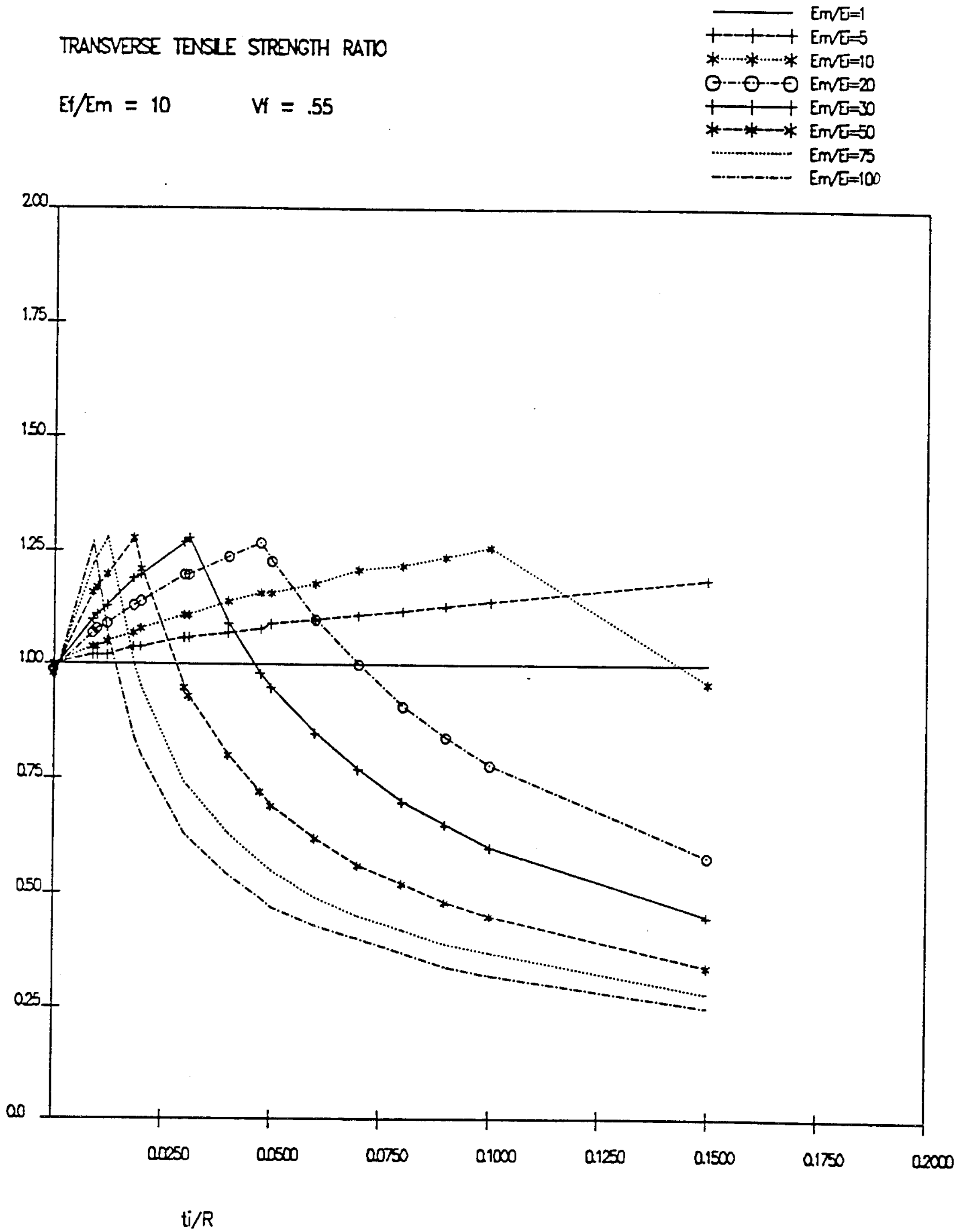
Ef / Em =100.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

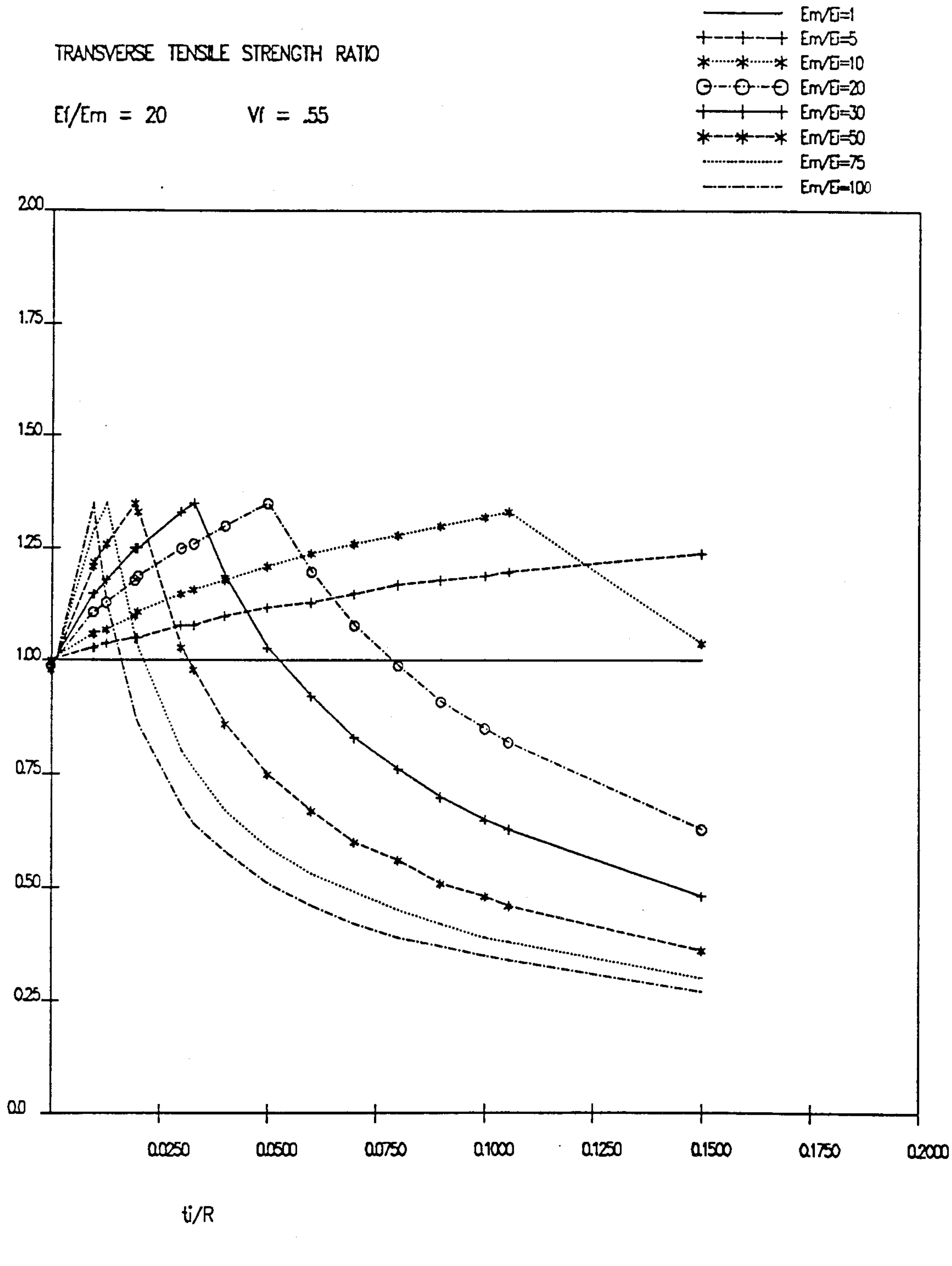
Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.03	1.06	1.09	1.11	1.13	1.15	1.17
5.0	1.00	1.04	1.07	1.10	1.13	1.15	1.17	1.19
5.9	1.00	1.05	1.09	1.12	1.15	1.18	1.20	1.22
7.6	1.00	1.06	1.11	1.15	1.19	1.22	1.24	1.27
10.0	1.00	1.08	1.14	1.19	1.23	1.26	1.29	1.32
10.9	1.00	1.09	1.15	1.20	1.24	1.28	1.31	1.34
12.0	1.00	1.09	1.16	1.22	1.26	1.30	1.33	1.36
13.4	1.00	1.10	1.18	1.23	1.28	1.32	1.36	1.39
15.1	1.00	1.11	1.19	1.25	1.30	1.35	1.39	1.42
17.5	1.00	1.13	1.21	1.28	1.34	1.38	1.43	1.29
20.0	1.00	1.14	1.24	1.31	1.37	1.42	1.30	1.17
20.8	1.00	1.15	1.24	1.32	1.38	1.43	1.27	1.14
25.8	1.00	1.17	1.28	1.36	1.43	1.24	1.10	0.99
30.0	1.00	1.19	1.31	1.40	1.29	1.12	0.99	0.89
34.0	1.00	1.21	1.34	1.43	1.19	1.03	0.91	0.82
50.0	1.00	1.27	1.43	1.12	0.93	0.80	0.72	0.65
50.5	1.00	1.28	1.44	1.11	0.92	0.80	0.71	0.64
75.0	1.00	1.36	1.11	0.86	0.72	0.63	0.57	0.52
100.0	1.00	1.43	0.93	0.73	0.62	0.54	0.49	0.45
100.0	1.00	1.43	0.93	0.73	0.62	0.54	0.49	0.45
Em/Ei cr		100.00	50.50	34.00	25.75	20.80	17.50	15.14

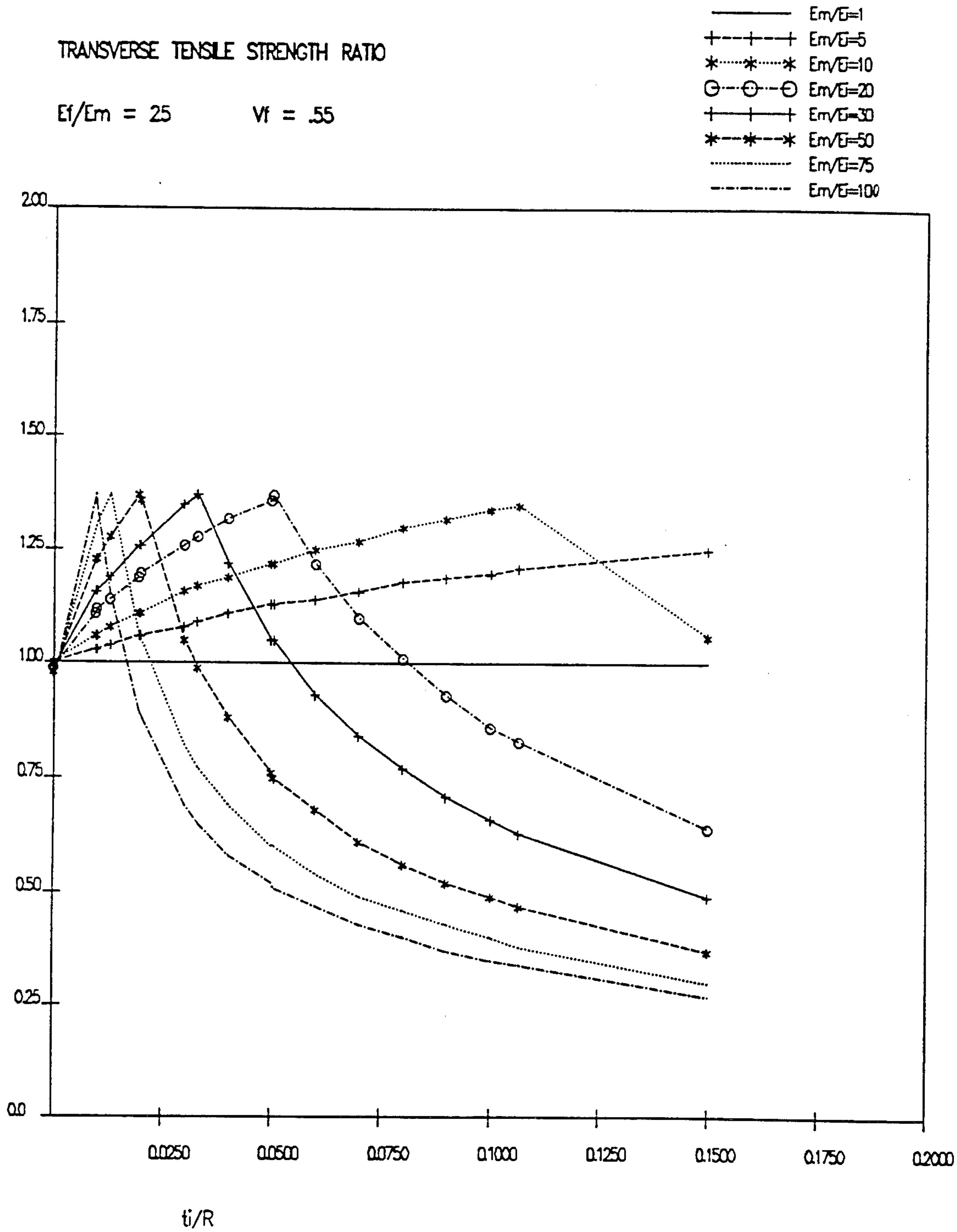
Em/Ei	ti / R 0.08	0.09	0.10	0.15
1.0	1.00	1.00	1.00	1.00
4.3	1.19	1.20	1.21	1.27
5.0	1.21	1.23	1.24	1.30
5.9	1.24	1.26	1.28	1.34
7.6	1.29	1.31	1.33	1.39
10.0	1.35	1.37	1.39	1.13
10.9	1.37	1.39	1.41	1.06
12.0	1.39	1.42	1.32	0.98
13.4	1.42	1.31	1.22	0.90
15.1	1.30	1.20	1.11	0.83
17.5	1.18	1.08	1.01	0.74
20.0	1.07	0.99	0.92	0.68
20.8	1.04	0.96	0.89	0.66
25.8	0.90	0.83	0.77	0.57
30.0	0.81	0.75	0.70	0.52
34.0	0.75	0.69	0.64	0.48
50.0	0.60	0.55	0.51	0.39
50.5	0.59	0.55	0.51	0.38
75.0	0.48	0.45	0.42	0.32
100.0	0.42	0.39	0.37	0.29
100.0	0.42	0.39	0.37	0.29
Em/Ei cr	13.38	12.00	10.90	7.60

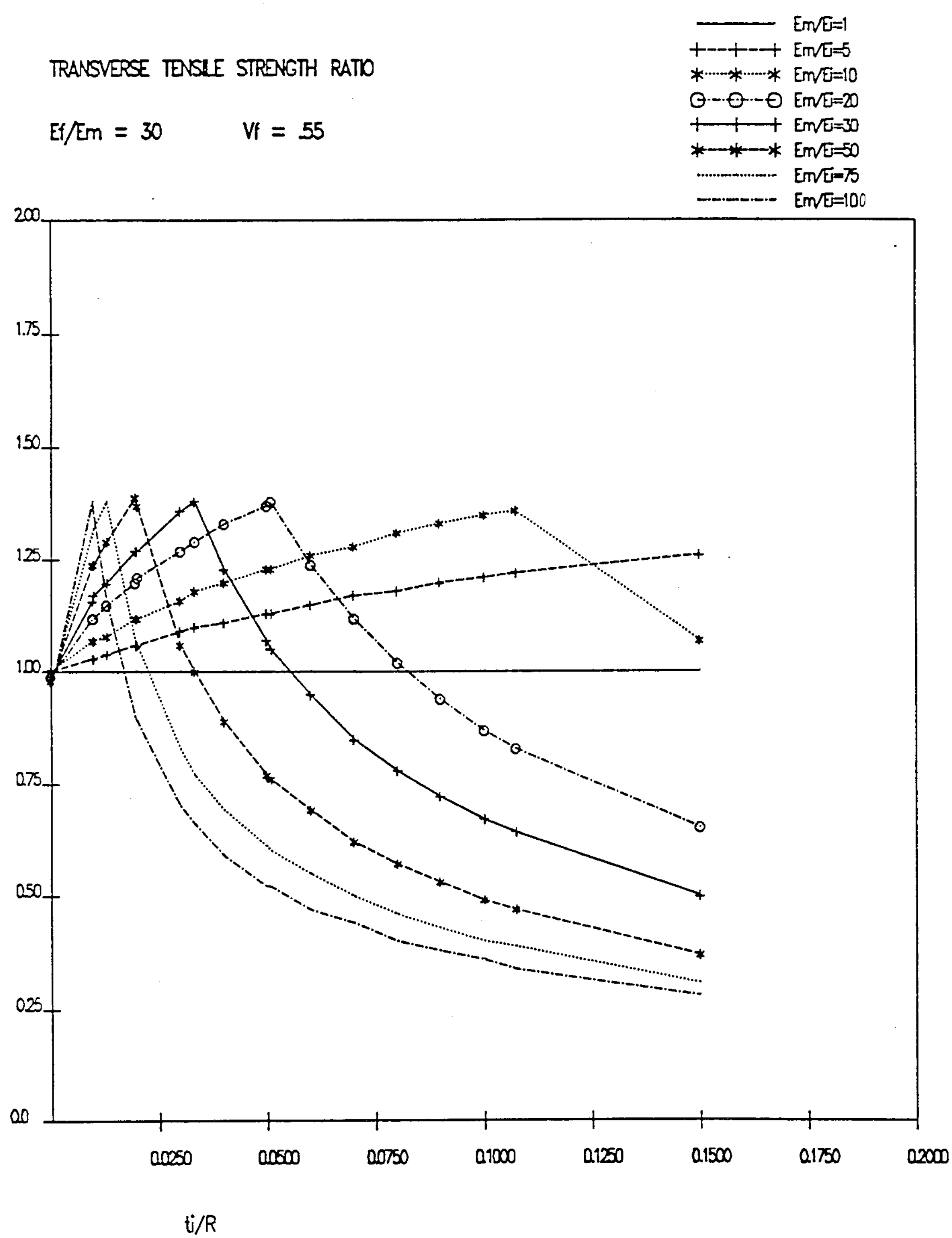

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5 Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R

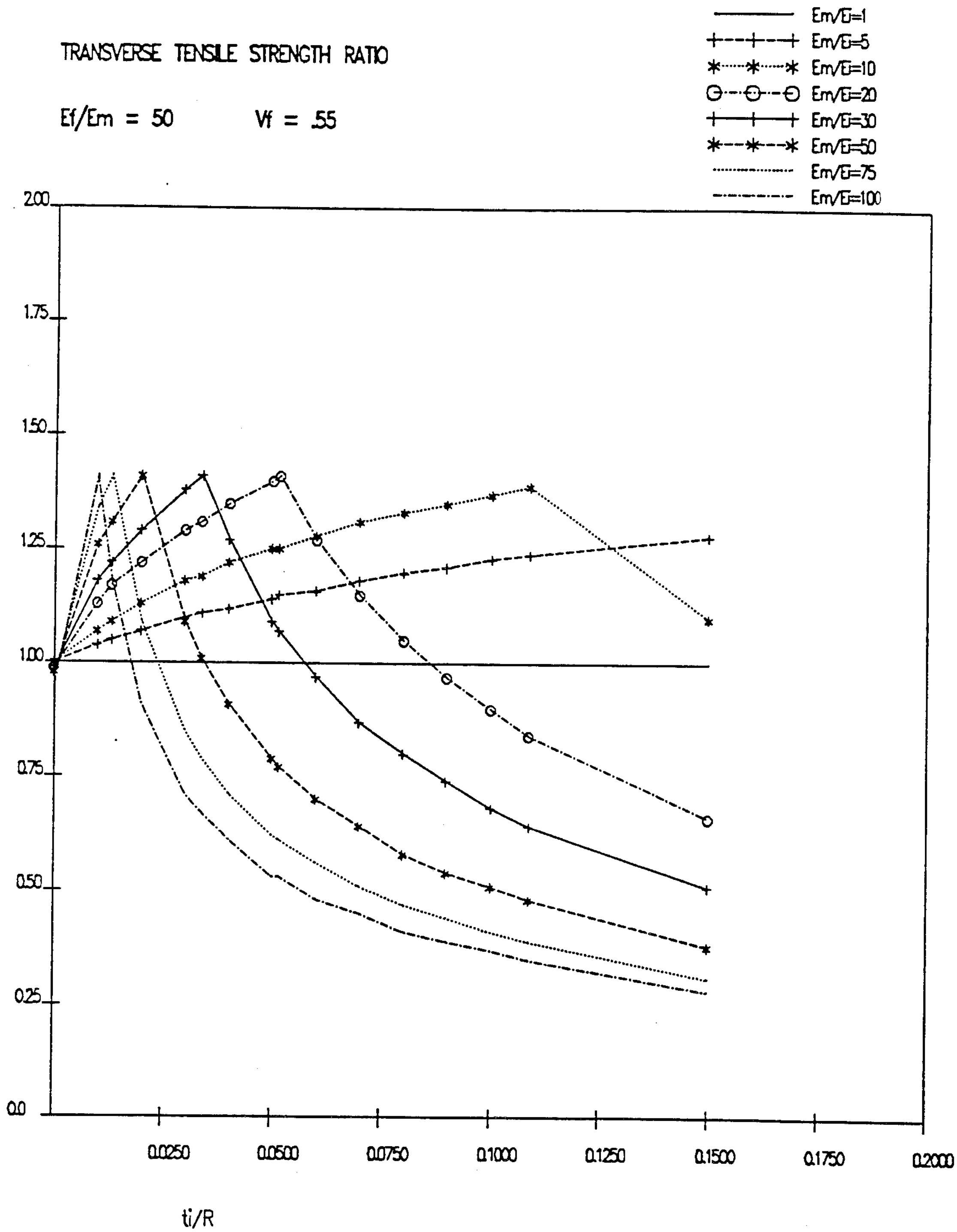


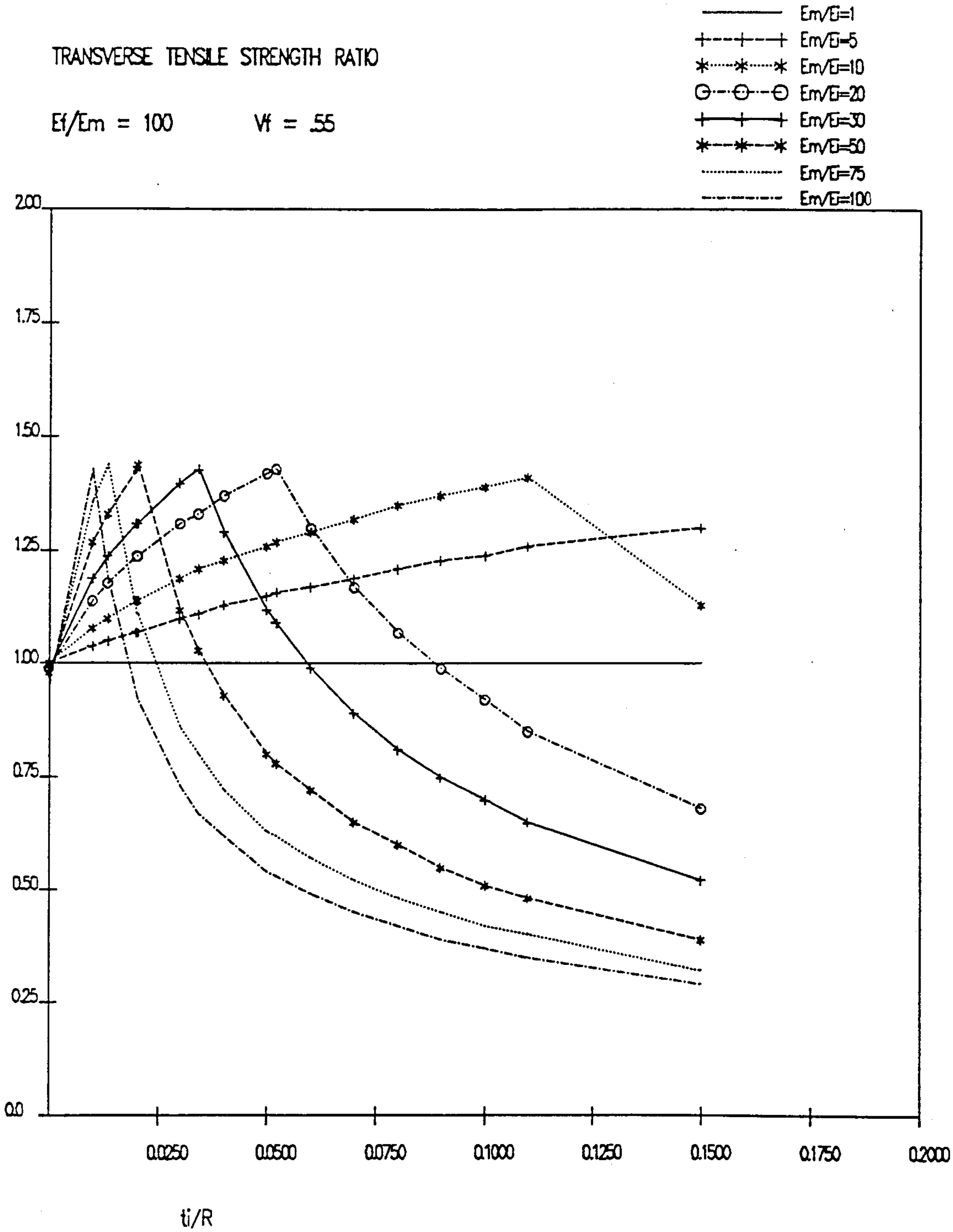
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30 Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .55
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
0.1500
0.1750
0.2000
ti/R

tratout Fri Dec 18 14:44:28 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.99	0.98	0.97
0.008	1.00	1.01	1.02	1.03	1.05	1.09	1.13	1.17
0.010	1.00	1.01	1.02	1.04	1.07	1.11	1.16	1.04
0.011	1.00	1.01	1.02	1.05	1.07	1.12	1.17	1.00
0.016	1.00	1.02	1.03	1.07	1.11	1.17	0.93	0.79
0.020	1.00	1.02	1.04	1.09	1.13	1.05	0.83	0.71
0.028	1.00	1.03	1.06	1.12	1.17	0.87	0.69	0.59
0.030	1.00	1.03	1.06	1.13	1.12	0.83	0.66	0.56
0.040	1.00	1.04	1.08	1.16	0.95	0.70	0.56	0.48
0.042	1.00	1.04	1.09	1.17	0.92	0.68	0.54	0.47
0.050	1.00	1.05	1.10	1.06	0.83	0.61	0.49	0.42
0.060	1.00	1.06	1.12	0.95	0.74	0.55	0.44	0.39
0.070	1.00	1.06	1.13	0.87	0.68	0.50	0.41	0.36
0.080	1.00	1.07	1.15	0.80	0.62	0.46	0.38	0.33
0.089	1.00	1.08	1.16	0.75	0.58	0.43	0.35	0.31
0.090	1.00	1.08	1.15	0.74	0.58	0.43	0.35	0.31
0.100	1.00	1.09	1.08	0.69	0.54	0.40	0.33	0.29
0.150	1.00	1.11	0.83	0.52	0.40	0.30	0.25	0.23
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout Fri Dec 18 14:44:36 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.009	1.00	1.02	1.04	1.07	1.10	1.16	1.22	1.27
0.010	1.00	1.02	1.04	1.08	1.11	1.17	1.24	1.21
0.012	1.00	1.02	1.05	1.09	1.13	1.20	1.28	1.07
0.018	1.00	1.04	1.07	1.13	1.19	1.28	1.00	0.84
0.020	1.00	1.04	1.08	1.14	1.20	1.21	0.95	0.80
0.030	1.00	1.06	1.11	1.20	1.27	0.95	0.74	0.63
0.031	1.00	1.06	1.11	1.20	1.28	0.93	0.73	0.62
0.040	1.00	1.07	1.14	1.24	1.09	0.80	0.63	0.54
0.047	1.00	1.08	1.16	1.27	0.98	0.72	0.57	0.49
0.050	1.00	1.09	1.16	1.23	0.95	0.69	0.55	0.47
0.060	1.00	1.10	1.18	1.10	0.85	0.62	0.49	0.43
0.070	1.00	1.11	1.21	1.00	0.77	0.56	0.45	0.40
0.080	1.00	1.12	1.22	0.91	0.70	0.52	0.42	0.37
0.090	1.00	1.13	1.24	0.84	0.65	0.48	0.39	0.34
0.100	1.00	1.14	1.26	0.78	0.60	0.45	0.37	0.32
0.100	1.00	1.14	1.26	0.78	0.60	0.45	0.37	0.32
0.150	1.00	1.19	0.96	0.58	0.45	0.34	0.28	0.25
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout Fri Dec 18 14:44:47 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.03	1.06	1.11	1.15	1.21	1.29	1.35
0.010	1.00	1.03	1.06	1.11	1.15	1.22	1.29	1.32
0.013	1.00	1.04	1.07	1.13	1.18	1.26	1.35	1.13
0.019	1.00	1.05	1.10	1.18	1.25	1.35	1.05	0.88
0.020	1.00	1.05	1.11	1.19	1.25	1.33	1.03	0.86
0.030	1.00	1.08	1.15	1.25	1.33	1.03	0.80	0.68
0.033	1.00	1.08	1.16	1.26	1.35	0.98	0.76	0.64
0.040	1.00	1.10	1.18	1.30	1.19	0.86	0.67	0.58
0.050	1.00	1.12	1.21	1.35	1.03	0.75	0.59	0.51
0.050	1.00	1.12	1.21	1.35	1.03	0.75	0.59	0.51
0.060	1.00	1.13	1.24	1.20	0.92	0.67	0.53	0.46
0.070	1.00	1.15	1.26	1.08	0.83	0.60	0.49	0.42
0.080	1.00	1.17	1.28	0.99	0.76	0.56	0.45	0.39
0.090	1.00	1.18	1.30	0.91	0.70	0.51	0.42	0.37
0.100	1.00	1.19	1.32	0.85	0.65	0.48	0.39	0.35
0.106	1.00	1.20	1.33	0.82	0.63	0.46	0.38	0.34
0.150	1.00	1.24	1.04	0.63	0.48	0.36	0.30	0.27
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout Fri Dec 18 14:44:53 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.03	1.06	1.11	1.16	1.23	1.30	1.37
0.010	1.00	1.03	1.06	1.12	1.16	1.23	1.31	1.34
0.013	1.00	1.04	1.08	1.14	1.19	1.28	1.37	1.15
0.020	1.00	1.06	1.11	1.19	1.26	1.37	1.06	0.89
0.020	1.00	1.06	1.11	1.20	1.26	1.36	1.05	0.88
0.030	1.00	1.08	1.16	1.26	1.35	1.05	0.82	0.69
0.033	1.00	1.09	1.17	1.28	1.37	0.99	0.77	0.65
0.040	1.00	1.11	1.19	1.32	1.22	0.88	0.69	0.58
0.050	1.00	1.13	1.22	1.36	1.05	0.76	0.60	0.52
0.051	1.00	1.13	1.22	1.37	1.05	0.75	0.60	0.51
0.060	1.00	1.14	1.25	1.22	0.93	0.68	0.54	0.47
0.070	1.00	1.16	1.27	1.10	0.84	0.61	0.49	0.43
0.080	1.00	1.18	1.30	1.01	0.77	0.56	0.46	0.40
0.090	1.00	1.19	1.32	0.93	0.71	0.52	0.43	0.37
0.100	1.00	1.20	1.34	0.86	0.66	0.49	0.40	0.35
0.107	1.00	1.21	1.35	0.83	0.63	0.47	0.38	0.34
0.150	1.00	1.25	1.06	0.64	0.49	0.37	0.30	0.27
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 14:45:02 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.010	1.00	1.03	1.07	1.12	1.16	1.24	1.31	1.38
0.010	1.00	1.03	1.07	1.12	1.17	1.24	1.32	1.36
0.013	1.00	1.04	1.08	1.15	1.20	1.29	1.38	1.16
0.020	1.00	1.06	1.12	1.20	1.27	1.39	1.07	0.90
0.020	1.00	1.06	1.12	1.21	1.27	1.37	1.06	0.89
0.030	1.00	1.09	1.16	1.27	1.36	1.06	0.83	0.70
0.033	1.00	1.10	1.18	1.29	1.38	1.00	0.77	0.66
0.040	1.00	1.11	1.20	1.33	1.23	0.89	0.69	0.59
0.050	1.00	1.13	1.23	1.37	1.07	0.77	0.61	0.52
0.051	1.00	1.13	1.23	1.38	1.05	0.76	0.60	0.52
0.060	1.00	1.15	1.26	1.24	0.95	0.69	0.55	0.47
0.070	1.00	1.17	1.28	1.12	0.85	0.62	0.50	0.44
0.080	1.00	1.18	1.31	1.02	0.78	0.57	0.46	0.40
0.090	1.00	1.20	1.33	0.94	0.72	0.53	0.43	0.38
0.100	1.00	1.21	1.35	0.87	0.67	0.49	0.40	0.36
0.107	1.00	1.22	1.36	0.83	0.64	0.47	0.39	0.34
0.150	1.00	1.26	1.07	0.65	0.50	0.37	0.31	0.28
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 14:45:10 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.55 max ti/R = 0.195

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.95
0.010	1.00	1.04	1.07	1.13	1.18	1.26	1.34	1.41
0.010	1.00	1.04	1.07	1.13	1.18	1.26	1.34	1.40
0.013	1.00	1.05	1.09	1.17	1.22	1.31	1.41	1.18
0.020	1.00	1.07	1.13	1.22	1.29	1.41	1.09	0.91
0.020	1.00	1.07	1.13	1.22	1.29	1.41	1.09	0.91
0.030	1.00	1.10	1.18	1.29	1.38	1.09	0.85	0.71
0.034	1.00	1.11	1.19	1.31	1.41	1.01	0.79	0.67
0.040	1.00	1.12	1.22	1.35	1.27	0.91	0.71	0.61
0.050	1.00	1.14	1.25	1.40	1.09	0.79	0.62	0.53
0.052	1.00	1.15	1.25	1.41	1.07	0.77	0.61	0.53
0.060	1.00	1.16	1.28	1.27	0.97	0.70	0.56	0.48
0.070	1.00	1.18	1.31	1.15	0.87	0.64	0.51	0.45
0.080	1.00	1.20	1.33	1.05	0.80	0.58	0.47	0.41
0.090	1.00	1.21	1.35	0.97	0.74	0.54	0.44	0.39
0.100	1.00	1.23	1.37	0.90	0.68	0.51	0.41	0.37
0.109	1.00	1.24	1.39	0.84	0.64	0.48	0.39	0.35
0.150	1.00	1.28	1.10	0.66	0.51	0.38	0.31	0.28
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Fri Dec 18 14:45:23 1992 1

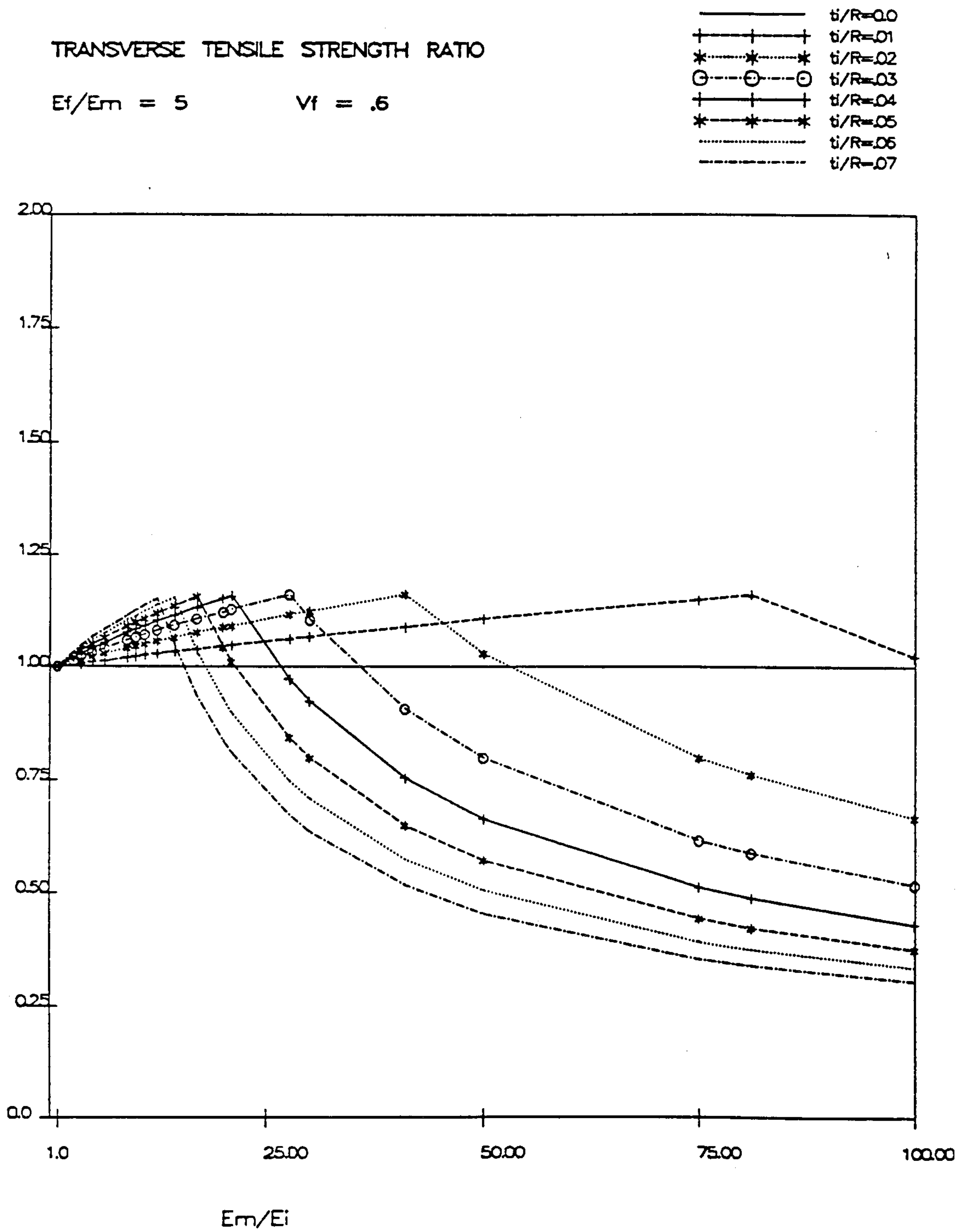
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

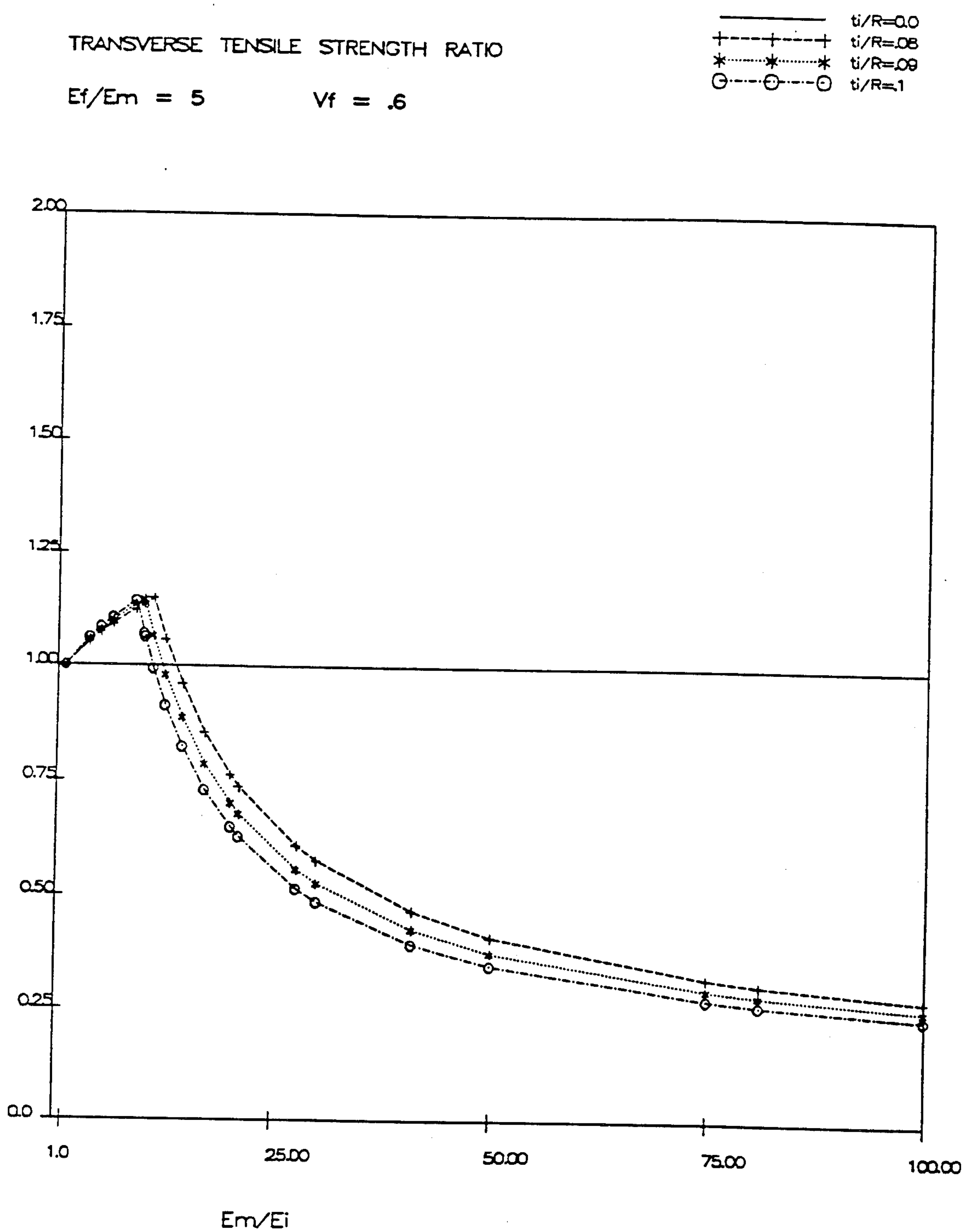
Ef / Em =100.0 Vf = 0.55 max ti/R = 0.195

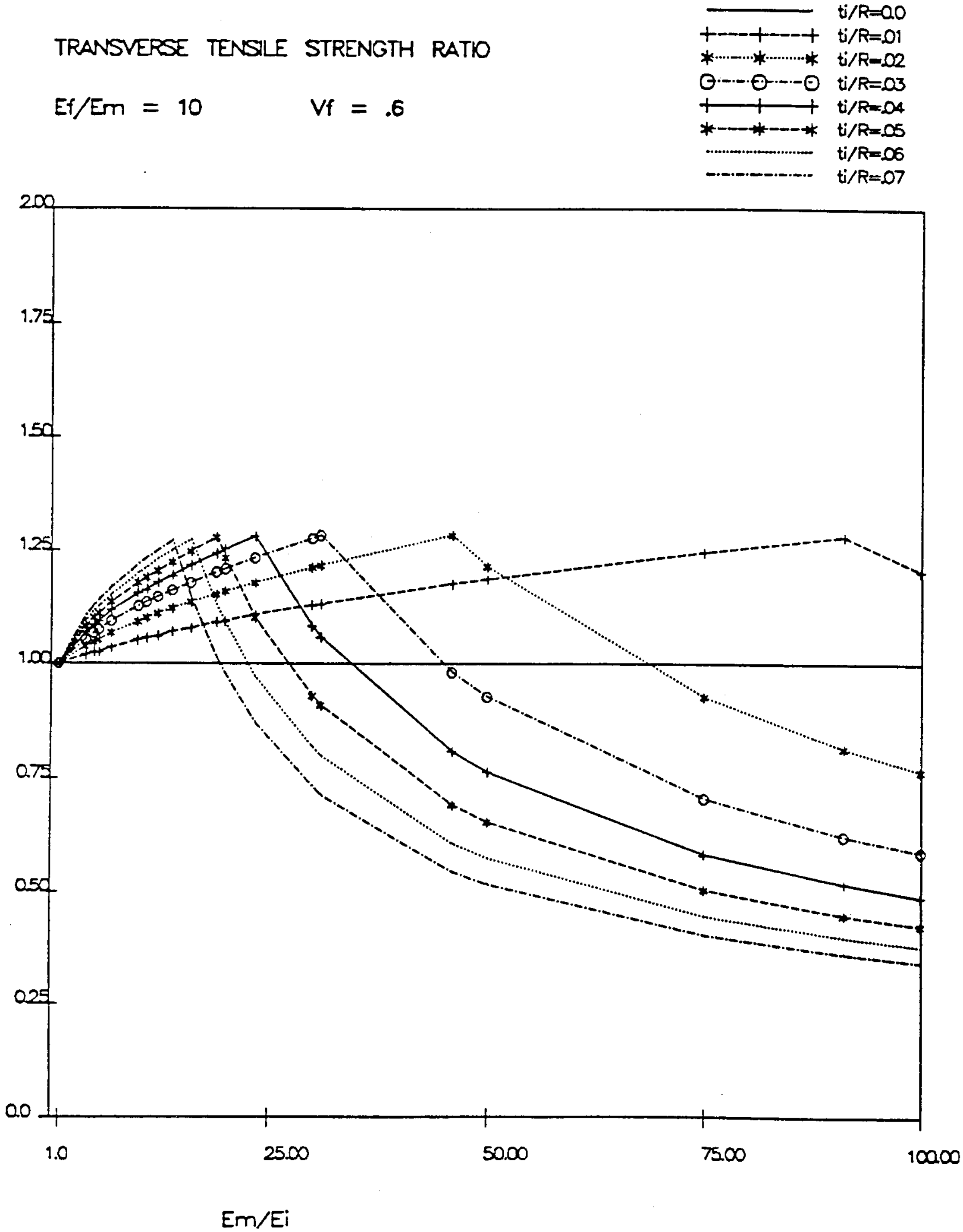
TRANSVERSE TENSILE STRENGTH RATIO

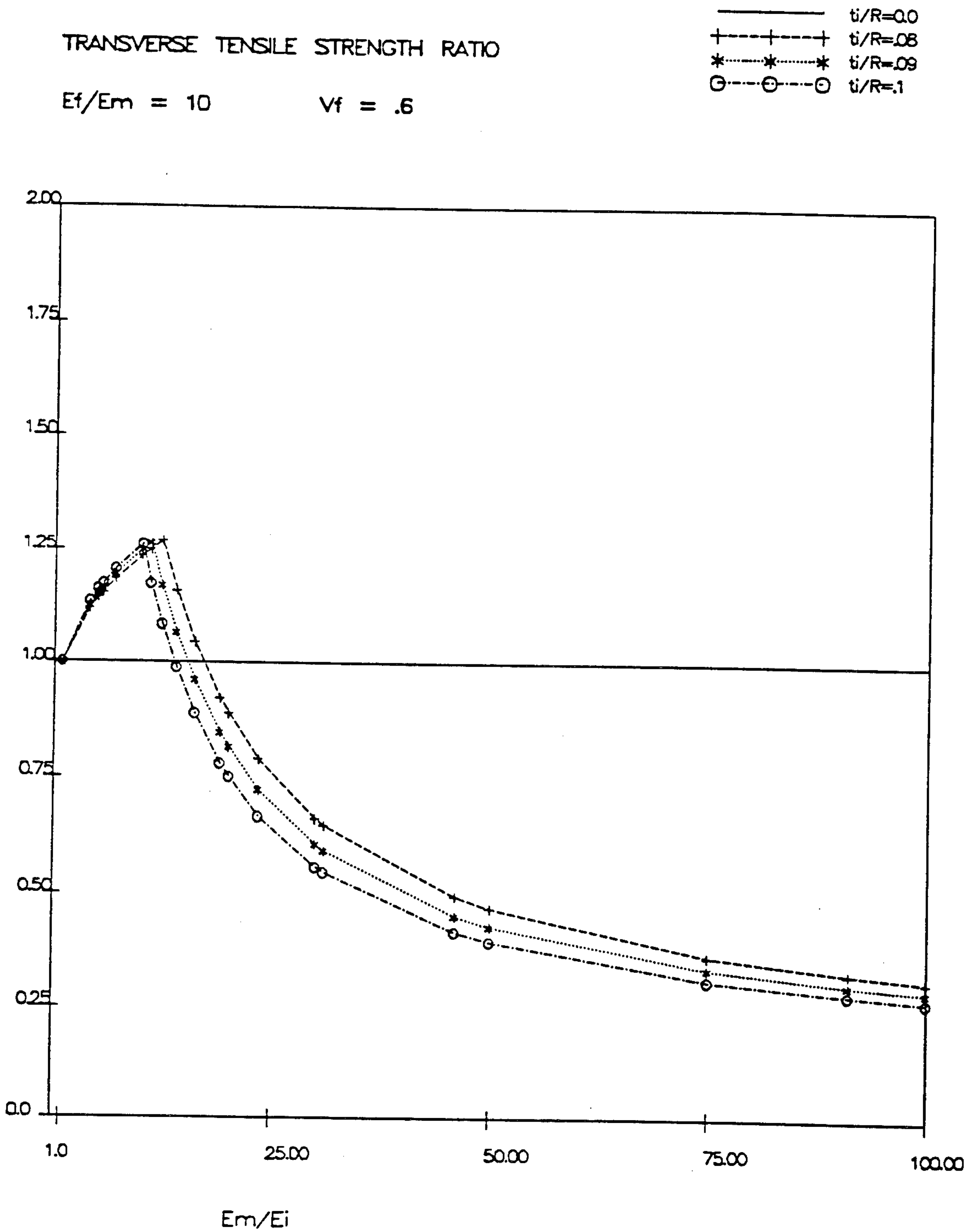
	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.96	0.95
0.010	1.00	1.04	1.08	1.14	1.19	1.27	1.36	1.43
0.010	1.00	1.04	1.08	1.14	1.19	1.27	1.36	1.43
0.013	1.00	1.05	1.10	1.18	1.24	1.33	1.44	1.19
0.020	1.00	1.07	1.14	1.24	1.31	1.43	1.11	0.93
0.020	1.00	1.07	1.14	1.24	1.31	1.44	1.11	0.92
0.030	1.00	1.10	1.19	1.31	1.40	1.12	0.86	0.73
0.034	1.00	1.11	1.21	1.33	1.43	1.03	0.80	0.67
0.040	1.00	1.13	1.23	1.37	1.29	0.93	0.72	0.62
0.050	1.00	1.15	1.26	1.42	1.12	0.80	0.63	0.54
0.052	1.00	1.16	1.27	1.43	1.09	0.78	0.62	0.53
0.060	1.00	1.17	1.29	1.30	0.99	0.72	0.57	0.49
0.070	1.00	1.19	1.32	1.17	0.89	0.65	0.52	0.45
0.080	1.00	1.21	1.35	1.07	0.81	0.60	0.48	0.42
0.090	1.00	1.23	1.37	0.99	0.75	0.55	0.45	0.39
0.100	1.00	1.24	1.39	0.92	0.70	0.51	0.42	0.37
0.110	1.00	1.26	1.41	0.85	0.65	0.48	0.40	0.35
0.150	1.00	1.30	1.13	0.68	0.52	0.39	0.32	0.29
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010

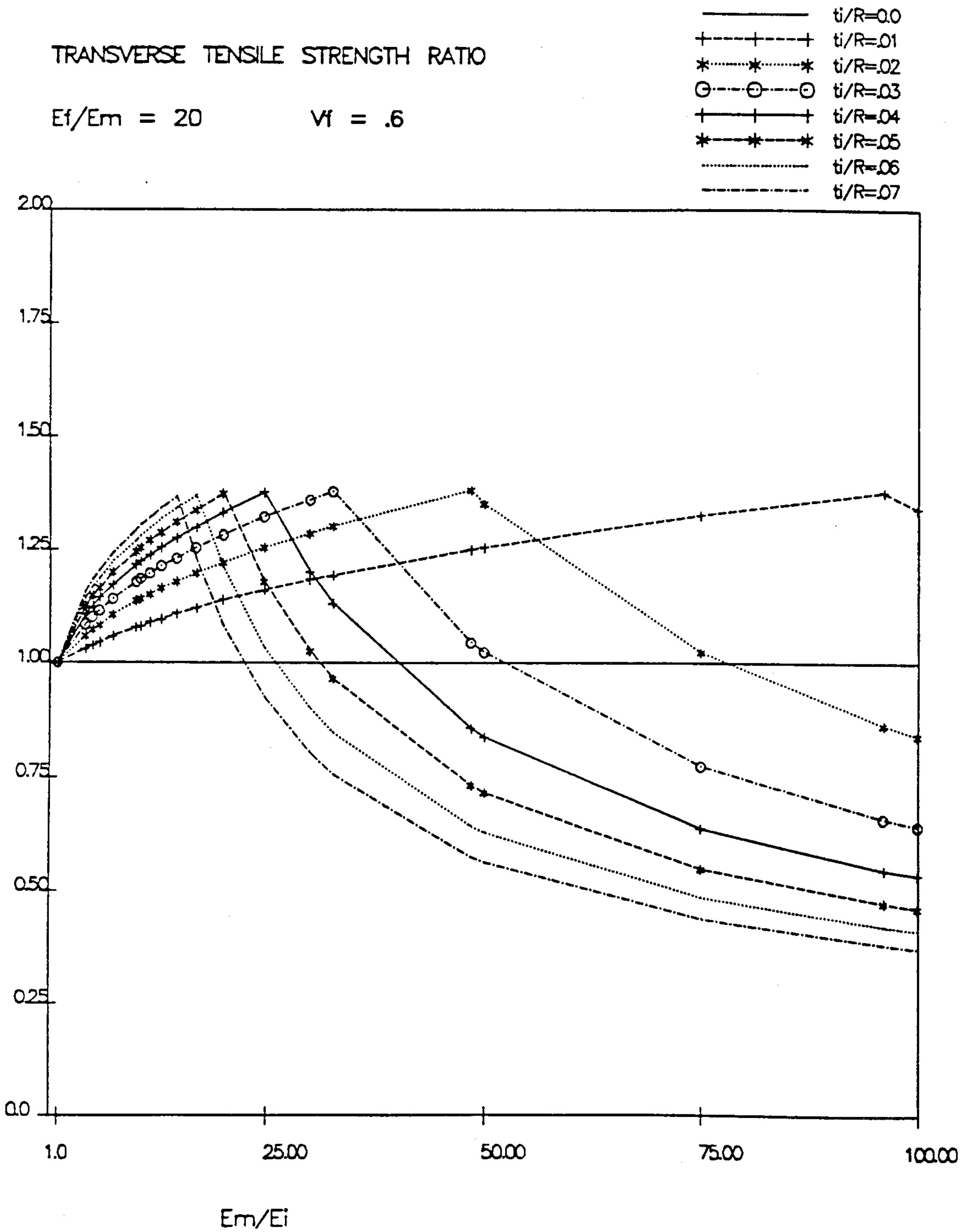


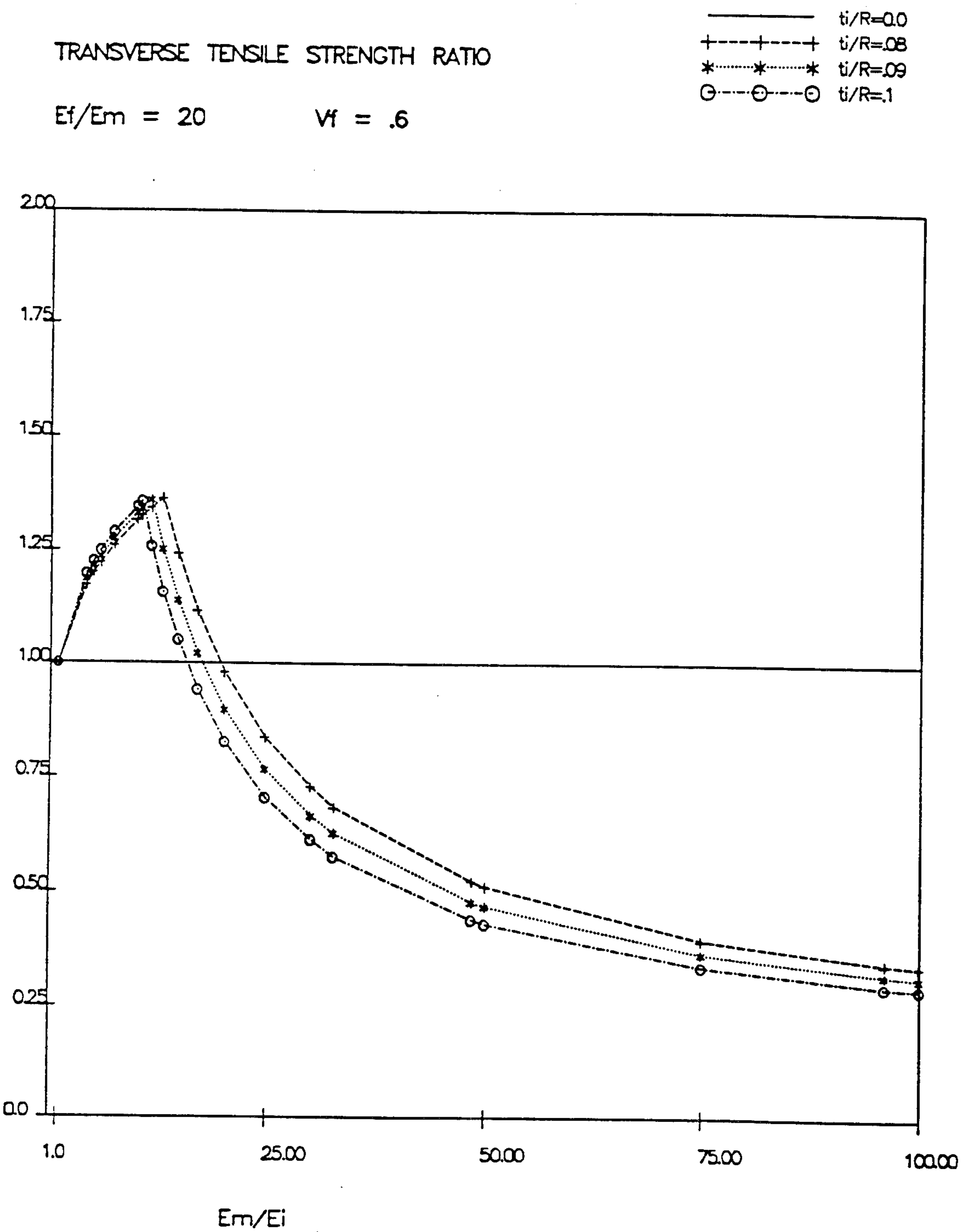
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

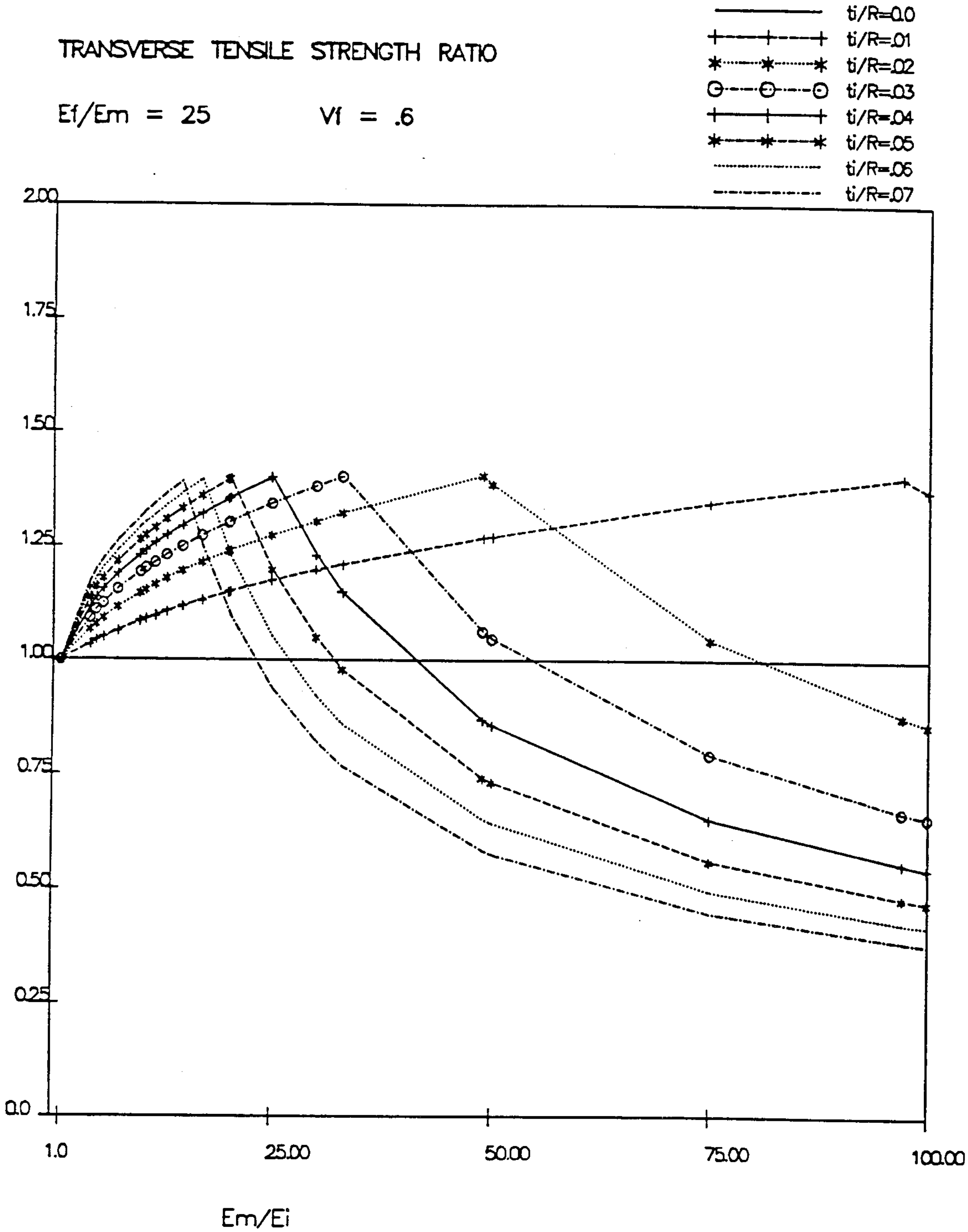

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .6
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

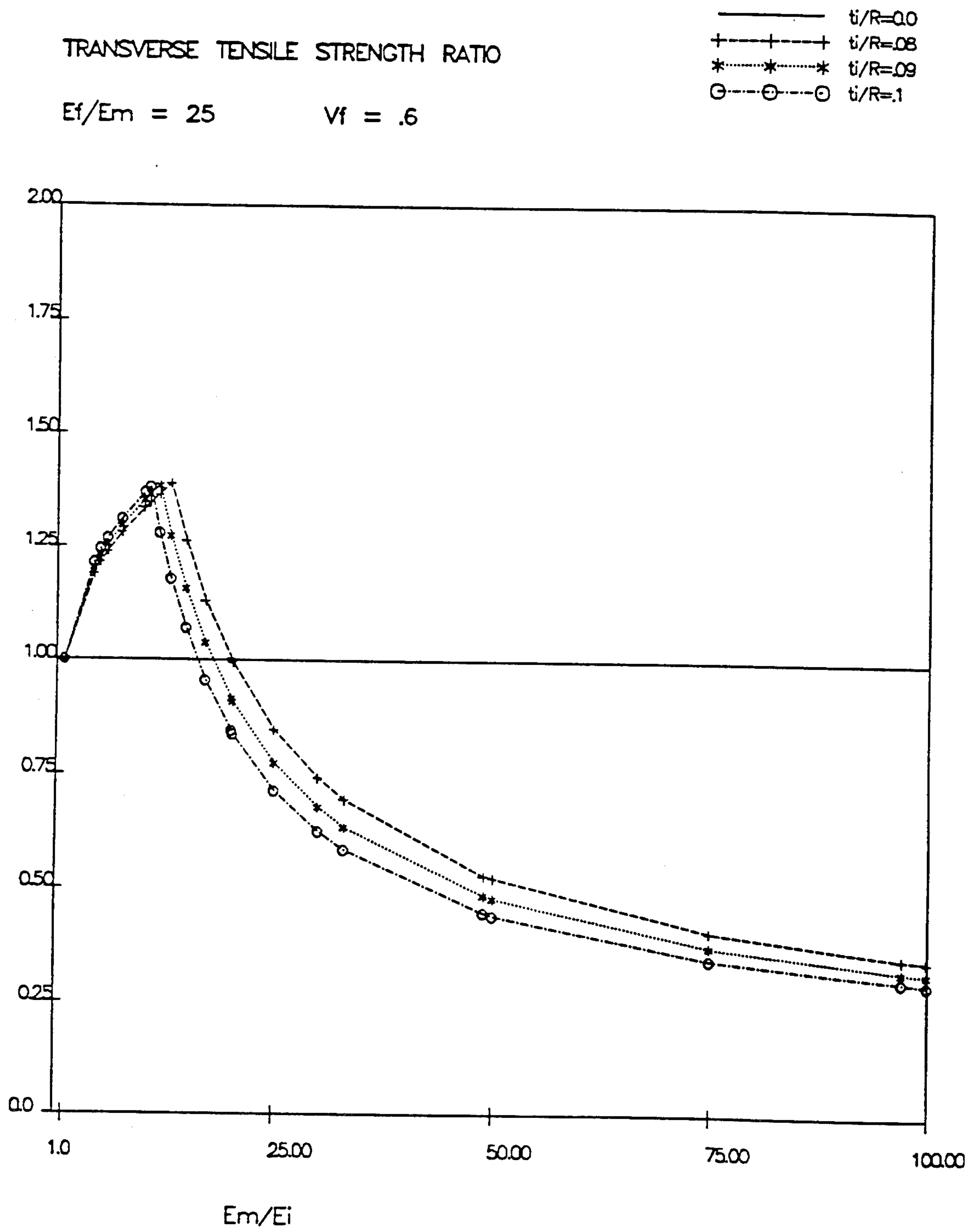

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

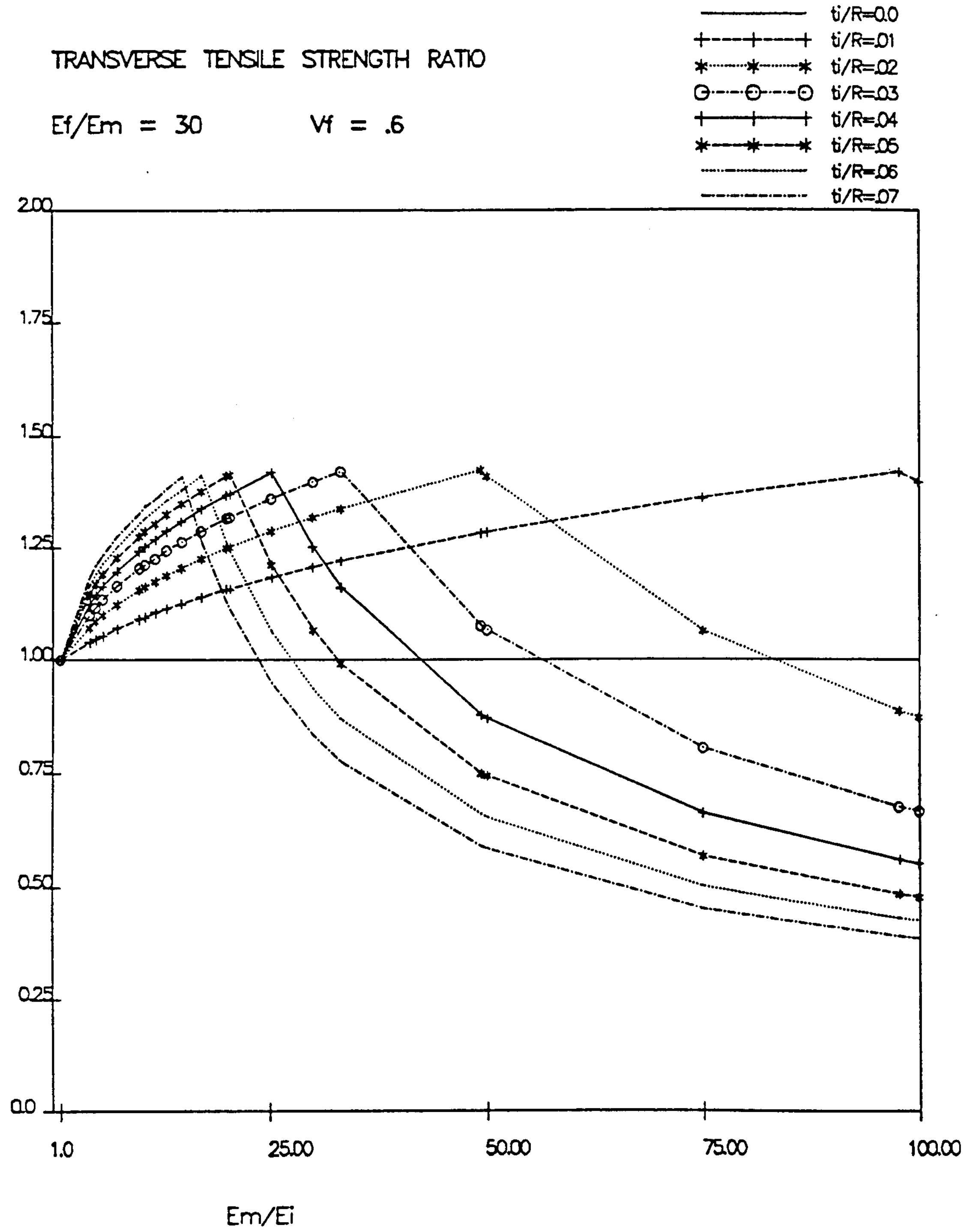

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .6
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

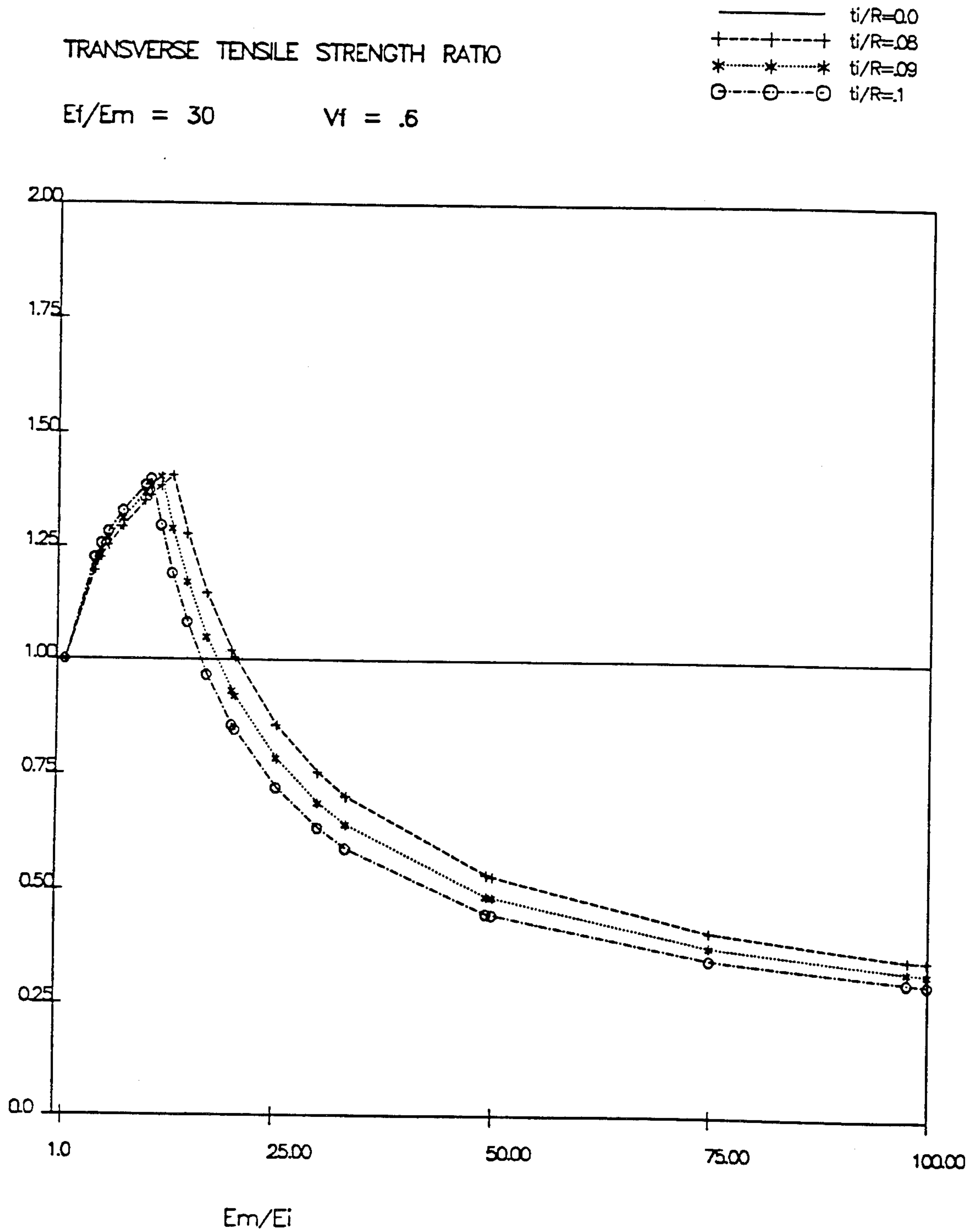

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

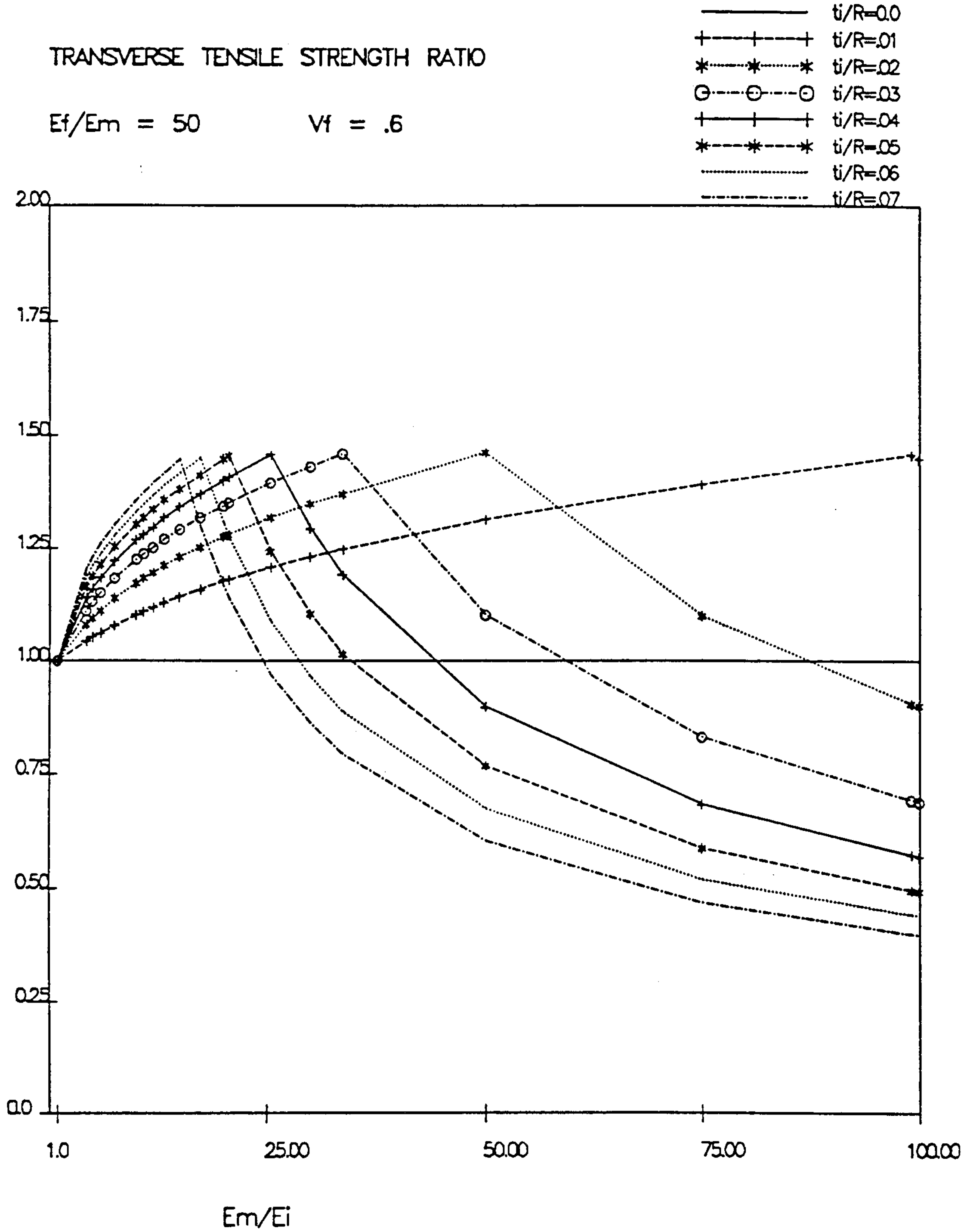

ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .6
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

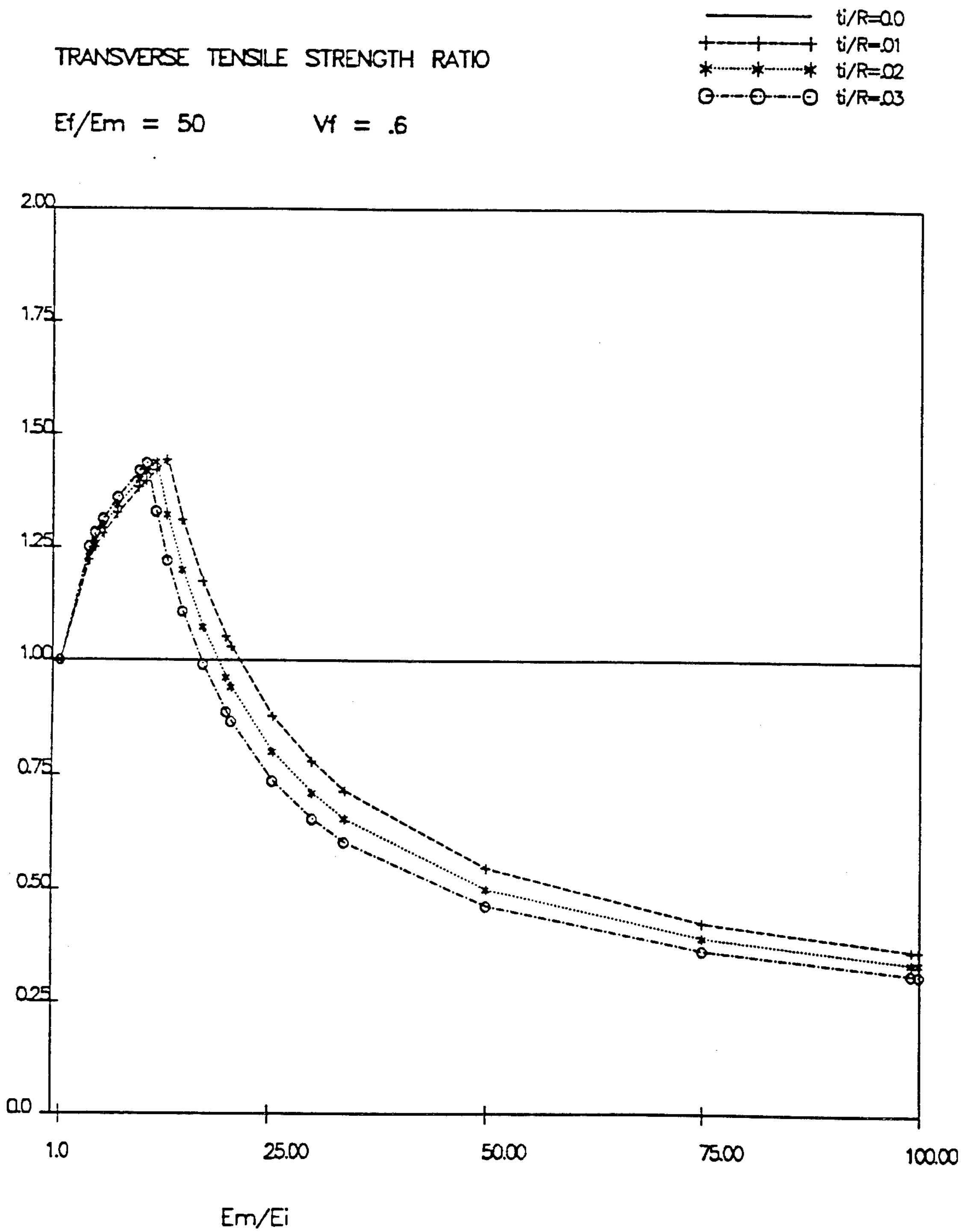

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .6
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

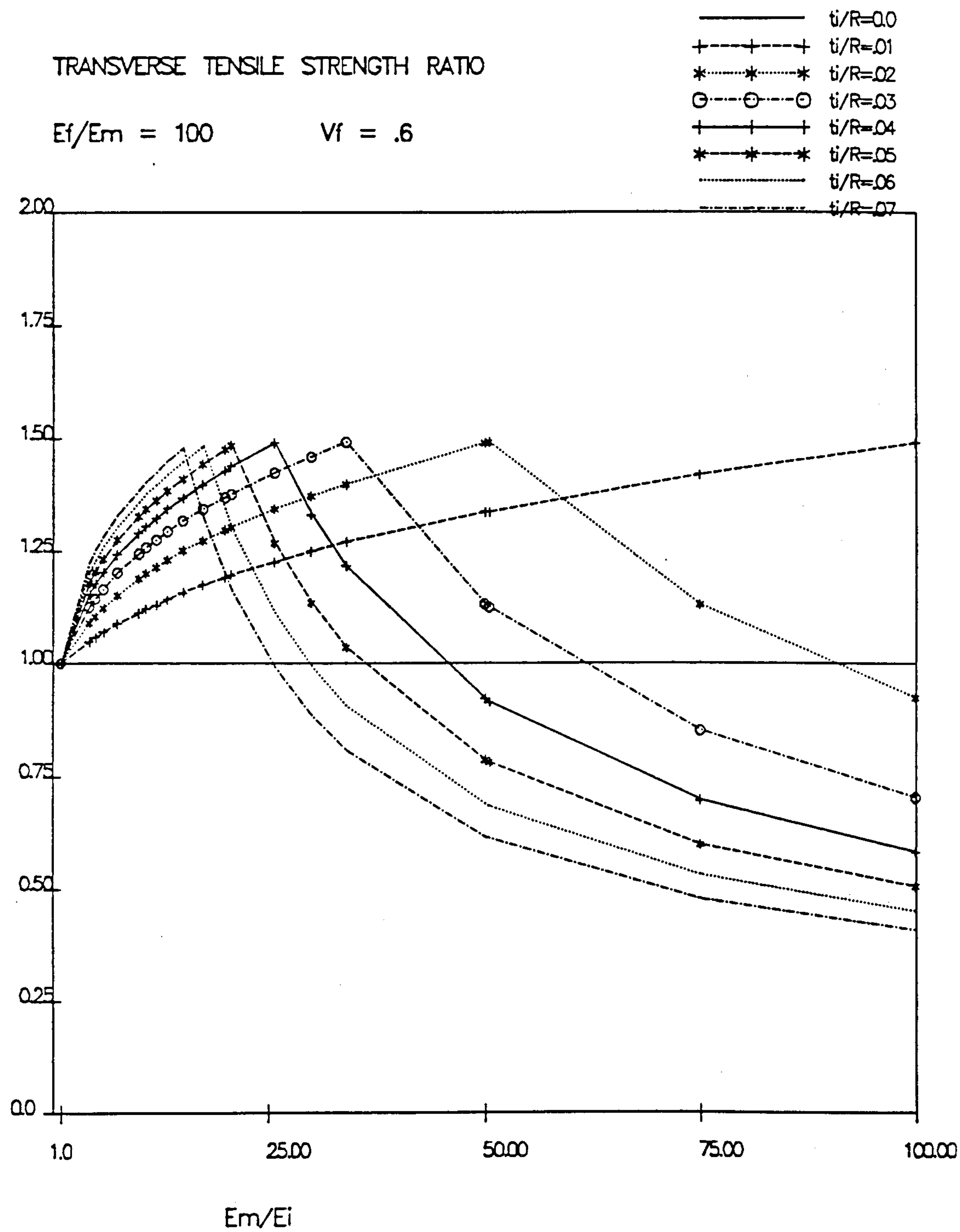

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30 Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

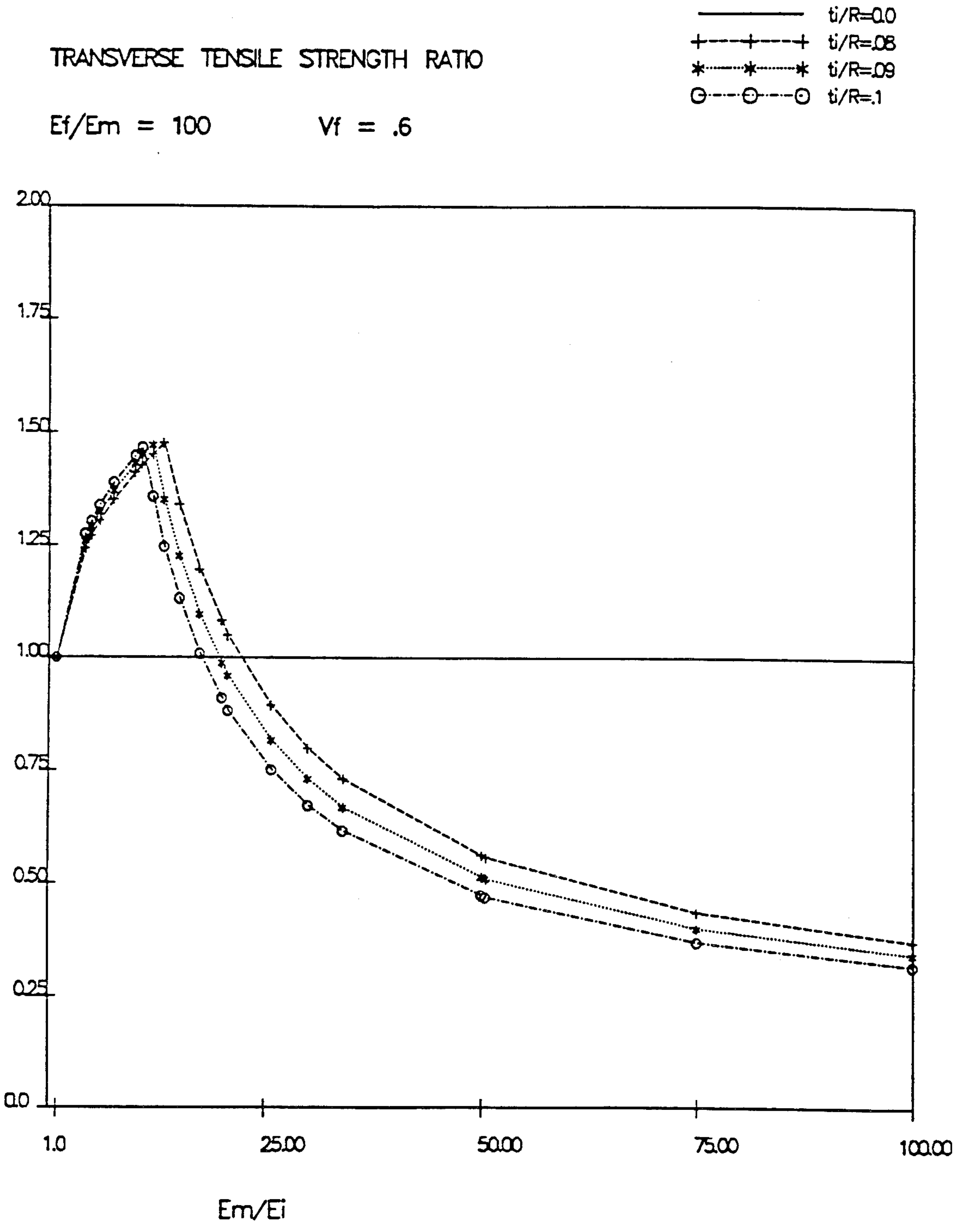

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .6
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .6
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100 Vf = .6
ti/R=0.0
ti/R=.08
ti/R=.09
ti/R=.1
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

tratout Thu Dec 17 15:10:54 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.7	1.00	1.01	1.01	1.02	1.03	1.04	1.04	1.05
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07
5.0	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07
6.3	1.00	1.01	1.03	1.04	1.05	1.07	1.08	1.08
9.0	1.00	1.02	1.04	1.06	1.08	1.09	1.10	1.12
9.9	1.00	1.02	1.05	1.07	1.08	1.10	1.11	1.13
10.0	1.00	1.02	1.05	1.07	1.08	1.10	1.11	1.13
11.0	1.00	1.03	1.05	1.07	1.09	1.11	1.12	1.14
12.4	1.00	1.03	1.06	1.08	1.10	1.12	1.14	1.15
14.3	1.00	1.03	1.06	1.09	1.11	1.14	1.15	1.05
17.0	1.00	1.04	1.08	1.11	1.13	1.16	1.03	0.94
20.0	1.00	1.05	1.09	1.12	1.15	1.04	0.93	0.84
21.0	1.00	1.05	1.09	1.13	1.16	1.01	0.90	0.81
27.7	1.00	1.06	1.12	1.16	0.97	0.84	0.75	0.67
30.0	1.00	1.07	1.12	1.11	0.92	0.80	0.71	0.63
41.0	1.00	1.09	1.16	0.91	0.75	0.65	0.57	0.51
50.0	1.00	1.11	1.03	0.80	0.66	0.57	0.50	0.45
75.0	1.00	1.15	0.80	0.62	0.51	0.44	0.39	0.35
81.0	1.00	1.16	0.76	0.59	0.49	0.42	0.38	0.34
100.0	1.00	1.02	0.66	0.51	0.43	0.37	0.33	0.30
Em/Ei cr		81.00	41.00	27.67	21.00	17.00	14.33	12.43

Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
3.7	1.05	1.06	1.06
5.0	1.07	1.08	1.09
5.0	1.07	1.08	1.09
6.3	1.09	1.10	1.11
9.0	1.13	1.14	1.14
9.9	1.14	1.15	1.07
10.0	1.14	1.14	1.06
11.0	1.15	1.07	1.00
12.4	1.06	0.98	0.91
14.3	0.96	0.89	0.83
17.0	0.85	0.79	0.73
20.0	0.76	0.70	0.65
21.0	0.74	0.68	0.63
27.7	0.61	0.56	0.52
30.0	0.58	0.53	0.49
41.0	0.47	0.43	0.40
50.0	0.41	0.38	0.35
75.0	0.32	0.30	0.28
81.0	0.31	0.29	0.26
100.0	0.28	0.26	0.24
Em/Ei cr	11.00	9.89	9.00

tratout   Thu Dec 17 15:10:58 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0   Vf = 0.60   max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R: 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.0	1.00	1.02	1.04	1.05	1.07	1.08	1.10	1.11
5.0	1.00	1.03	1.05	1.07	1.09	1.10	1.12	1.13
5.5	1.00	1.03	1.05	1.08	1.10	1.11	1.13	1.14
7.0	1.00	1.04	1.07	1.10	1.12	1.14	1.16	1.17
10.0	1.00	1.05	1.09	1.13	1.16	1.18	1.20	1.22
10.0	1.00	1.05	1.09	1.13	1.16	1.18	1.20	1.22
11.0	1.00	1.06	1.10	1.14	1.17	1.19	1.21	1.23
12.2	1.00	1.06	1.11	1.15	1.18	1.21	1.23	1.25
13.9	1.00	1.07	1.12	1.16	1.20	1.23	1.25	1.27
16.0	1.00	1.08	1.14	1.18	1.22	1.25	1.28	1.15
19.0	1.00	1.09	1.16	1.20	1.24	1.28	1.13	1.01
20.0	1.00	1.10	1.16	1.21	1.25	1.23	1.09	0.98
23.5	1.00	1.11	1.18	1.24	1.28	1.10	0.97	0.87
30.0	1.00	1.13	1.21	1.28	1.08	0.93	0.82	0.73
31.0	1.00	1.13	1.22	1.28	1.06	0.91	0.80	0.71
46.0	1.00	1.18	1.28	0.98	0.81	0.69	0.61	0.55
50.0	1.00	1.19	1.22	0.93	0.76	0.65	0.58	0.52
75.0	1.00	1.25	0.93	0.71	0.58	0.50	0.45	0.40
91.0	1.00	1.28	0.82	0.62	0.52	0.45	0.40	0.36
100.0	1.00	1.21	0.77	0.59	0.49	0.42	0.38	0.34
Em/Ei cr		91.00	46.00	31.00	23.50	19.00	16.00	13.86

Em/Ei	ti / R: 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.0	1.12	1.13	1.14
5.0	1.14	1.15	1.16
5.5	1.15	1.17	1.18
7.0	1.18	1.20	1.21
10.0	1.24	1.25	1.26
10.0	1.24	1.25	1.26
11.0	1.25	1.27	1.18
12.2	1.27	1.17	1.09
13.9	1.16	1.07	0.99
16.0	1.05	0.96	0.89
19.0	0.92	0.85	0.78
20.0	0.89	0.81	0.75
23.5	0.79	0.72	0.67
30.0	0.66	0.61	0.56
31.0	0.65	0.59	0.55
46.0	0.49	0.45	0.42
50.0	0.47	0.43	0.40
75.0	0.37	0.34	0.31
91.0	0.33	0.30	0.28
100.0	0.31	0.29	0.27
Em/Ei cr	12.25	11.00	10.00

tratout   Thu Dec 17 15:11:05 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0   Vf = 0.60   max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.03	1.06	1.09	1.11	1.13	1.14	1.16
5.0	1.00	1.04	1.07	1.10	1.13	1.15	1.17	1.19
5.8	1.00	1.05	1.08	1.12	1.14	1.17	1.19	1.21
7.3	1.00	1.06	1.11	1.14	1.17	1.20	1.22	1.24
10.0	1.00	1.08	1.14	1.18	1.22	1.25	1.27	1.30
10.5	1.00	1.08	1.14	1.19	1.22	1.25	1.28	1.30
11.6	1.00	1.09	1.15	1.20	1.24	1.27	1.30	1.32
12.9	1.00	1.10	1.17	1.22	1.26	1.29	1.32	1.34
14.6	1.00	1.11	1.18	1.23	1.28	1.31	1.34	1.37
16.8	1.00	1.12	1.20	1.26	1.30	1.34	1.37	1.23
20.0	1.00	1.14	1.22	1.28	1.33	1.37	1.21	1.08
20.0	1.00	1.14	1.22	1.28	1.33	1.37	1.21	1.08
24.8	1.00	1.16	1.26	1.32	1.38	1.18	1.04	0.92
30.0	1.00	1.18	1.29	1.36	1.20	1.03	0.90	0.80
32.7	1.00	1.20	1.30	1.38	1.13	0.97	0.85	0.76
48.5	1.00	1.25	1.38	1.05	0.86	0.73	0.64	0.58
50.0	1.00	1.26	1.35	1.03	0.84	0.72	0.63	0.56
75.0	1.00	1.33	1.02	0.78	0.64	0.55	0.49	0.44
96.0	1.00	1.38	0.87	0.66	0.55	0.47	0.42	0.38
100.0	1.00	1.34	0.84	0.64	0.53	0.46	0.41	0.37
Em/Ei cr		96.00	48.50	32.67	24.75	20.00	16.83	14.57

Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.2	1.17	1.19	1.20
5.0	1.20	1.22	1.23
5.8	1.22	1.24	1.25
7.3	1.26	1.28	1.29
10.0	1.32	1.33	1.35
10.5	1.32	1.34	1.36
11.6	1.34	1.36	1.26
12.9	1.36	1.25	1.16
14.6	1.24	1.14	1.05
16.8	1.12	1.02	0.94
20.0	0.98	0.90	0.83
20.0	0.98	0.90	0.83
24.8	0.84	0.76	0.70
30.0	0.73	0.66	0.61
32.7	0.68	0.63	0.58
48.5	0.52	0.48	0.44
50.0	0.51	0.47	0.43
75.0	0.40	0.37	0.34
96.0	0.35	0.32	0.30
100.0	0.34	0.32	0.29
Em/Ei cr	12.88	11.56	10.50

tratout Thu Dec 17 15:11:09 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.04	1.07	1.09	1.12	1.14	1.16	1.17
5.0	1.00	1.04	1.08	1.11	1.14	1.16	1.18	1.20
5.8	1.00	1.05	1.09	1.13	1.16	1.18	1.20	1.22
7.4	1.00	1.06	1.12	1.16	1.19	1.22	1.24	1.26
10.0	1.00	1.09	1.15	1.19	1.23	1.26	1.29	1.32
10.6	1.00	1.09	1.15	1.20	1.24	1.27	1.30	1.33
11.7	1.00	1.10	1.17	1.22	1.26	1.29	1.32	1.34
13.0	1.00	1.11	1.18	1.23	1.27	1.31	1.34	1.37
14.7	1.00	1.12	1.20	1.25	1.30	1.33	1.36	1.39
17.0	1.00	1.13	1.22	1.27	1.32	1.36	1.40	1.25
20.0	1.00	1.15	1.24	1.30	1.35	1.40	1.24	1.11
20.2	1.00	1.15	1.24	1.30	1.36	1.40	1.23	1.10
25.0	1.00	1.18	1.27	1.34	1.40	1.20	1.05	0.94
30.0	1.00	1.20	1.31	1.38	1.23	1.05	0.92	0.82
33.0	1.00	1.21	1.32	1.40	1.15	0.98	0.86	0.77
49.0	1.00	1.27	1.41	1.06	0.87	0.74	0.65	0.58
50.0	1.00	1.27	1.39	1.05	0.86	0.73	0.64	0.58
75.0	1.00	1.35	1.05	0.79	0.65	0.56	0.50	0.45
97.0	1.00	1.40	0.88	0.67	0.55	0.48	0.43	0.39
100.0	1.00	1.37	0.86	0.66	0.54	0.47	0.42	0.38
Em/Ei cr		97.00	49.00	33.00	25.00	20.20	17.00	14.71

Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.2	1.19	1.20	1.22
5.0	1.22	1.23	1.24
5.8	1.24	1.26	1.27
7.4	1.28	1.30	1.31
10.0	1.34	1.35	1.37
10.6	1.35	1.37	1.38
11.7	1.37	1.39	1.28
13.0	1.39	1.28	1.18
14.7	1.26	1.16	1.07
17.0	1.13	1.04	0.96
20.0	1.00	0.92	0.85
20.2	1.00	0.91	0.84
25.0	0.85	0.78	0.71
30.0	0.74	0.68	0.63
33.0	0.69	0.63	0.58
49.0	0.53	0.48	0.45
50.0	0.52	0.48	0.44
75.0	0.41	0.37	0.35
97.0	0.35	0.33	0.30
100.0	0.35	0.32	0.30
Em/Ei cr	13.00	11.67	10.60

tratout Thu Dec 17 15:11:14 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.04	1.07	1.10	1.12	1.15	1.17	1.18
5.0	1.00	1.05	1.08	1.12	1.15	1.17	1.19	1.21
5.8	1.00	1.05	1.10	1.13	1.17	1.19	1.21	1.23
7.4	1.00	1.07	1.12	1.16	1.20	1.23	1.25	1.28
10.0	1.00	1.09	1.16	1.20	1.24	1.28	1.30	1.33
10.7	1.00	1.10	1.16	1.21	1.25	1.29	1.32	1.34
11.7	1.00	1.10	1.18	1.23	1.27	1.30	1.33	1.36
13.1	1.00	1.11	1.19	1.24	1.29	1.32	1.36	1.38
14.8	1.00	1.13	1.21	1.26	1.31	1.35	1.38	1.41
17.1	1.00	1.14	1.23	1.29	1.34	1.38	1.41	1.27
20.0	1.00	1.16	1.25	1.32	1.37	1.41	1.26	1.13
20.3	1.00	1.16	1.25	1.32	1.37	1.42	1.24	1.11
25.2	1.00	1.19	1.29	1.36	1.42	1.21	1.06	0.95
30.0	1.00	1.21	1.32	1.40	1.25	1.07	0.94	0.83
33.2	1.00	1.22	1.34	1.42	1.16	0.99	0.87	0.78
49.3	1.00	1.28	1.42	1.08	0.88	0.75	0.66	0.59
50.0	1.00	1.29	1.41	1.07	0.87	0.74	0.65	0.58
75.0	1.00	1.36	1.06	0.81	0.66	0.57	0.50	0.45
97.7	1.00	1.42	0.89	0.68	0.56	0.49	0.43	0.39
100.0	1.00	1.40	0.87	0.67	0.55	0.48	0.43	0.39
Em/Ei cr		97.67	49.33	33.22	25.17	20.33	17.11	14.81

Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.2	1.20	1.21	1.23
5.0	1.23	1.24	1.26
5.8	1.25	1.27	1.28
7.4	1.30	1.31	1.33
10.0	1.35	1.37	1.39
10.7	1.36	1.38	1.40
11.7	1.38	1.40	1.30
13.1	1.41	1.29	1.19
14.8	1.28	1.17	1.08
17.1	1.15	1.05	0.97
20.0	1.02	0.93	0.86
20.3	1.01	0.92	0.85
25.2	0.86	0.78	0.72
30.0	0.75	0.69	0.63
33.2	0.70	0.64	0.59
49.3	0.53	0.49	0.45
50.0	0.53	0.49	0.45
75.0	0.41	0.38	0.35
97.7	0.36	0.33	0.31
100.0	0.35	0.33	0.30
Em/Ei cr	13.08	11.74	10.67

tratout   Thu Dec 17 15:11:19 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0   Vf = 0.60   max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.04	1.08	1.11	1.14	1.16	1.19	1.21
5.0	1.00	1.05	1.10	1.13	1.16	1.19	1.21	1.23
5.9	1.00	1.06	1.11	1.15	1.19	1.21	1.24	1.26
7.5	1.00	1.08	1.14	1.19	1.22	1.25	1.28	1.31
10.0	1.00	1.10	1.17	1.23	1.27	1.30	1.33	1.36
10.8	1.00	1.11	1.18	1.24	1.28	1.32	1.35	1.38
11.9	1.00	1.12	1.20	1.25	1.30	1.34	1.37	1.40
13.3	1.00	1.13	1.21	1.27	1.32	1.36	1.39	1.42
15.0	1.00	1.14	1.23	1.29	1.34	1.38	1.42	1.45
17.3	1.00	1.16	1.25	1.32	1.37	1.41	1.45	1.30
20.0	1.00	1.18	1.28	1.35	1.40	1.45	1.30	1.17
20.6	1.00	1.18	1.28	1.35	1.41	1.45	1.28	1.14
25.5	1.00	1.21	1.32	1.40	1.46	1.24	1.09	0.97
30.0	1.00	1.23	1.35	1.43	1.30	1.10	0.97	0.86
33.7	1.00	1.25	1.37	1.46	1.19	1.02	0.89	0.79
50.0	1.00	1.31	1.46	1.10	0.90	0.77	0.67	0.60
50.0	1.00	1.31	1.46	1.10	0.90	0.77	0.67	0.60
75.0	1.00	1.39	1.10	0.83	0.68	0.59	0.52	0.47
99.0	1.00	1.46	0.91	0.69	0.57	0.50	0.44	0.40
100.0	1.00	1.45	0.90	0.69	0.57	0.49	0.44	0.40
Em/Ei cr		99.00	50.00	33.67	25.50	20.60	17.33	15.00

Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.3	1.22	1.24	1.25
5.0	1.25	1.27	1.28
5.9	1.28	1.30	1.31
7.5	1.33	1.35	1.36
10.0	1.38	1.40	1.42
10.8	1.40	1.42	1.44
11.9	1.42	1.44	1.33
13.3	1.44	1.32	1.22
15.0	1.31	1.20	1.11
17.3	1.18	1.08	0.99
20.0	1.05	0.96	0.89
20.6	1.03	0.94	0.87
25.5	0.88	0.80	0.74
30.0	0.78	0.71	0.65
33.7	0.72	0.65	0.60
50.0	0.55	0.50	0.46
50.0	0.55	0.50	0.46
75.0	0.43	0.39	0.36
99.0	0.37	0.34	0.31
100.0	0.36	0.34	0.31
Em/Ei cr	13.25	11.89	10.80

tratout **Thu Dec 17 15:11:24 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

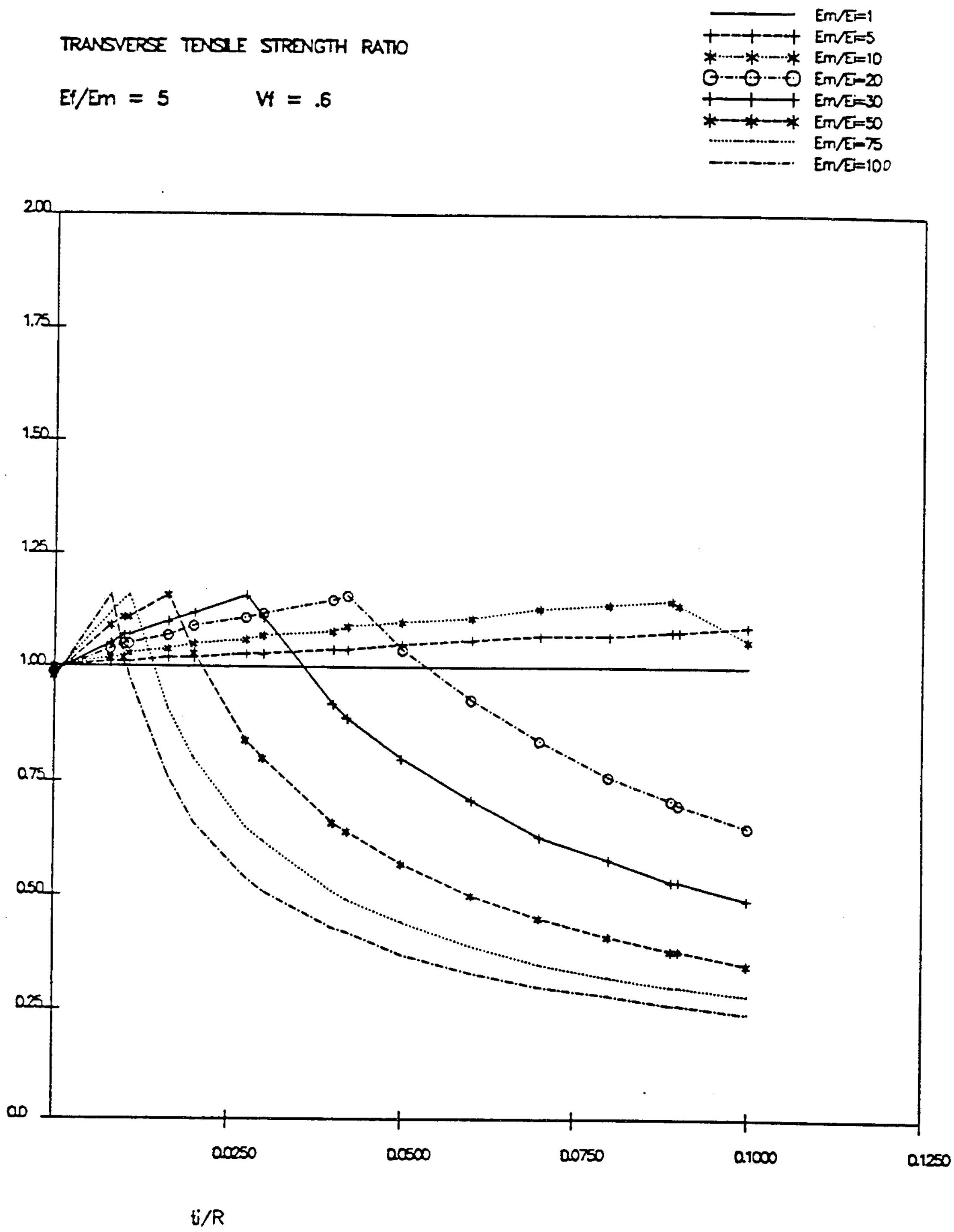
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

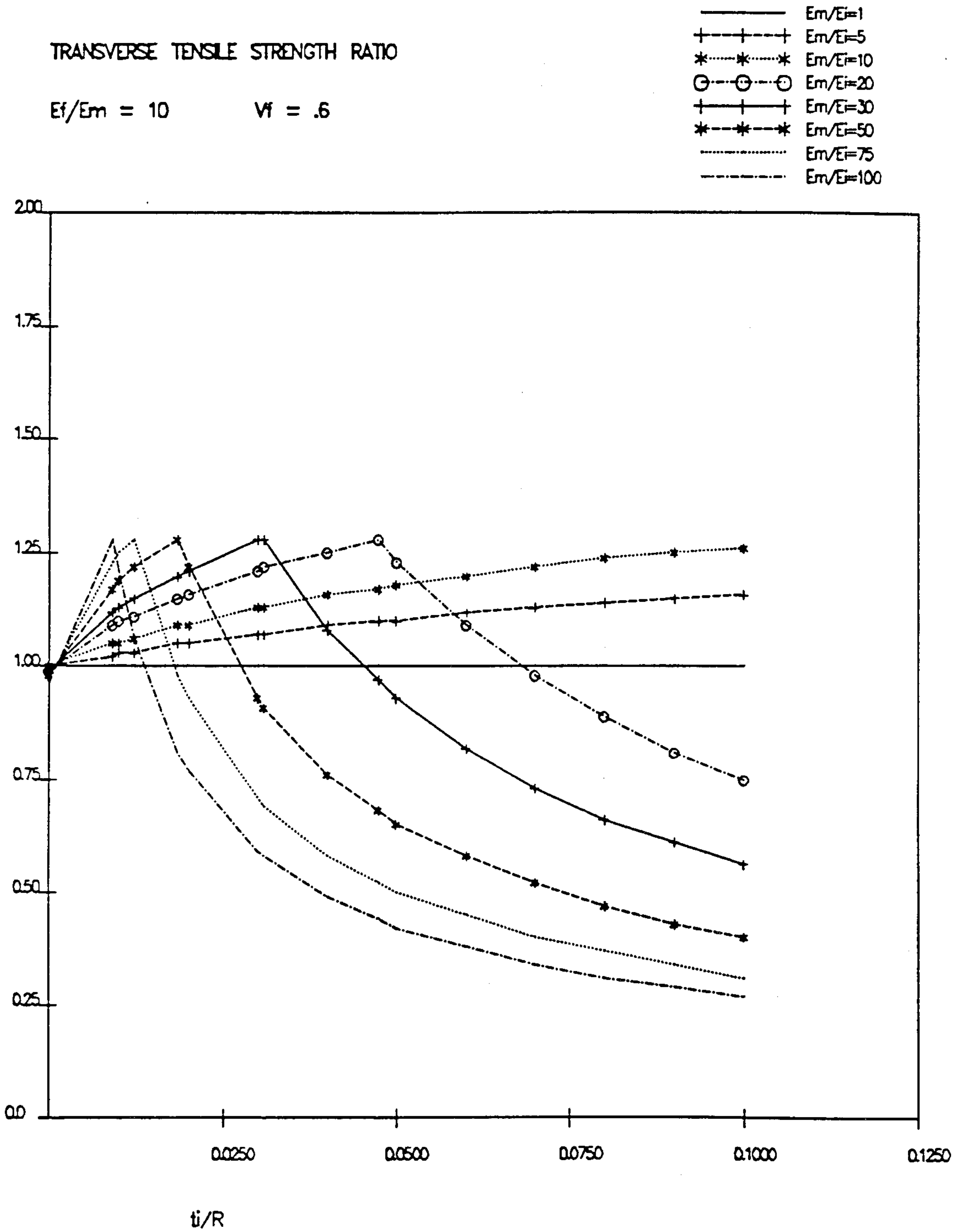
Ef / Em =100.0 Vf = 0.60 max ti/R = 0.144

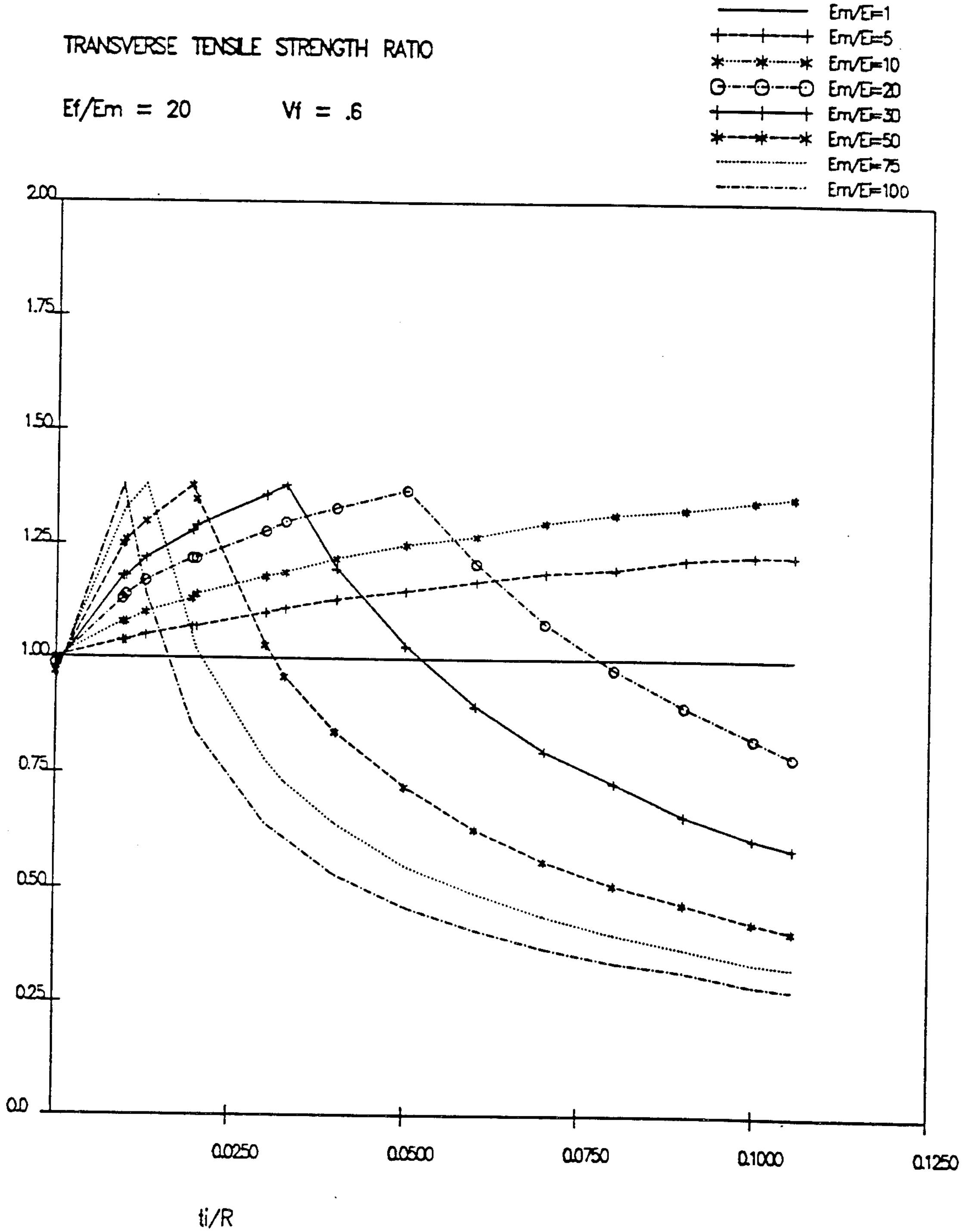
TRANSVERSE TENSILE STRENGTH RATIO

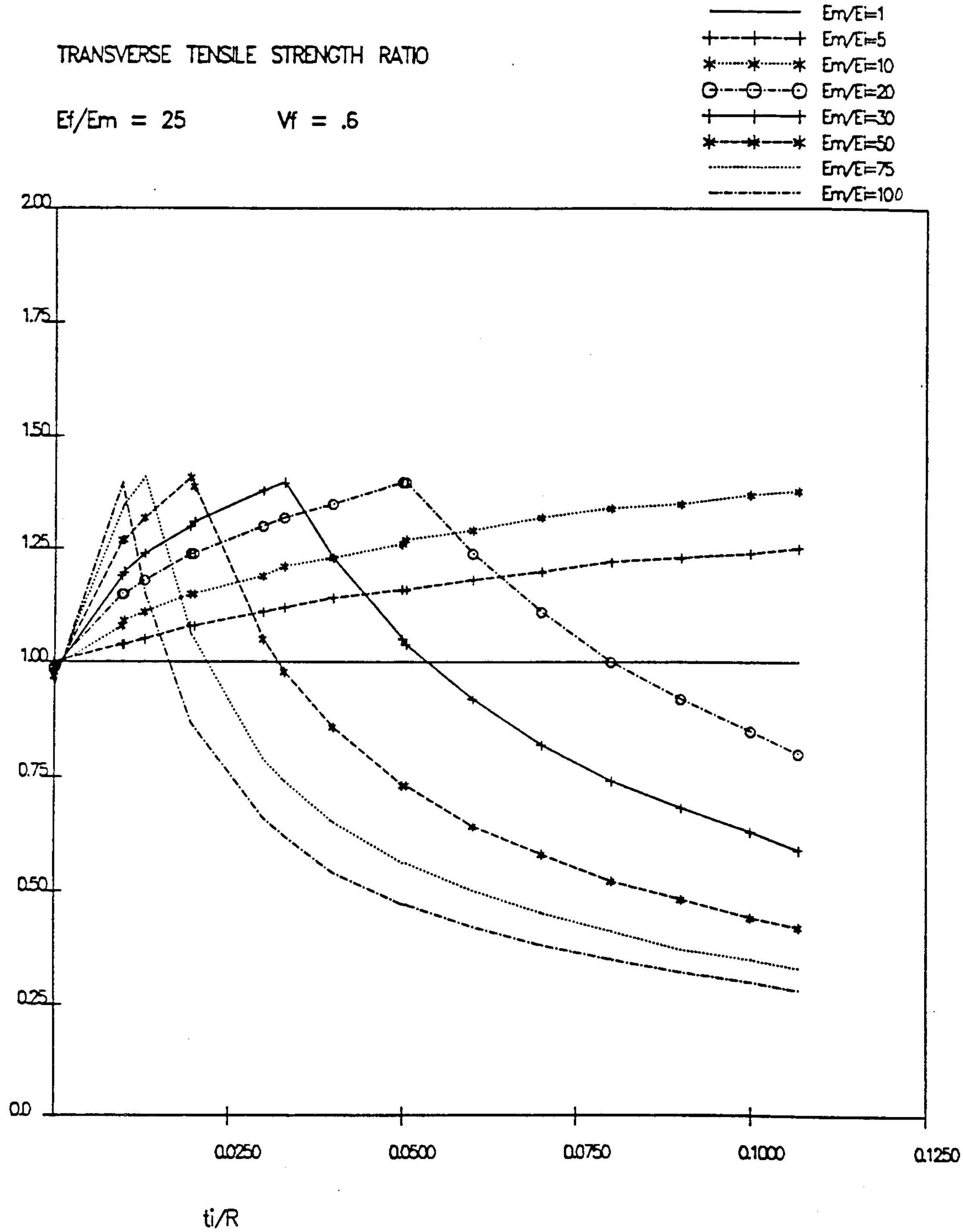
Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.05	1.09	1.12	1.15	1.18	1.20	1.23
5.0	1.00	1.06	1.10	1.14	1.18	1.21	1.23	1.25
5.9	1.00	1.07	1.12	1.17	1.20	1.23	1.26	1.28
7.6	1.00	1.09	1.15	1.20	1.24	1.28	1.31	1.33
10.0	1.00	1.11	1.19	1.25	1.29	1.33	1.36	1.39
10.9	1.00	1.12	1.20	1.26	1.31	1.34	1.38	1.40
12.0	1.00	1.13	1.22	1.28	1.32	1.36	1.40	1.43
13.4	1.00	1.14	1.23	1.30	1.34	1.39	1.42	1.45
15.1	1.00	1.16	1.25	1.32	1.37	1.41	1.45	1.48
17.5	1.00	1.18	1.28	1.34	1.40	1.44	1.48	1.33
20.0	1.00	1.19	1.30	1.37	1.43	1.48	1.34	1.20
20.8	1.00	1.20	1.30	1.38	1.44	1.49	1.30	1.16
25.8	1.00	1.23	1.34	1.43	1.49	1.27	1.11	0.99
30.0	1.00	1.25	1.37	1.46	1.33	1.14	0.99	0.88
34.0	1.00	1.27	1.40	1.49	1.22	1.04	0.91	0.81
50.0	1.00	1.34	1.49	1.13	0.92	0.79	0.69	0.62
50.5	1.00	1.34	1.49	1.12	0.92	0.78	0.69	0.61
75.0	1.00	1.42	1.13	0.85	0.70	0.60	0.53	0.48
100.0	1.00	1.49	0.93	0.70	0.58	0.51	0.45	0.41
100.0	1.00	1.49	0.93	0.70	0.58	0.51	0.45	0.41
Em/Ei cr		100.00	50.50	34.00	25.75	20.80	17.50	15.14

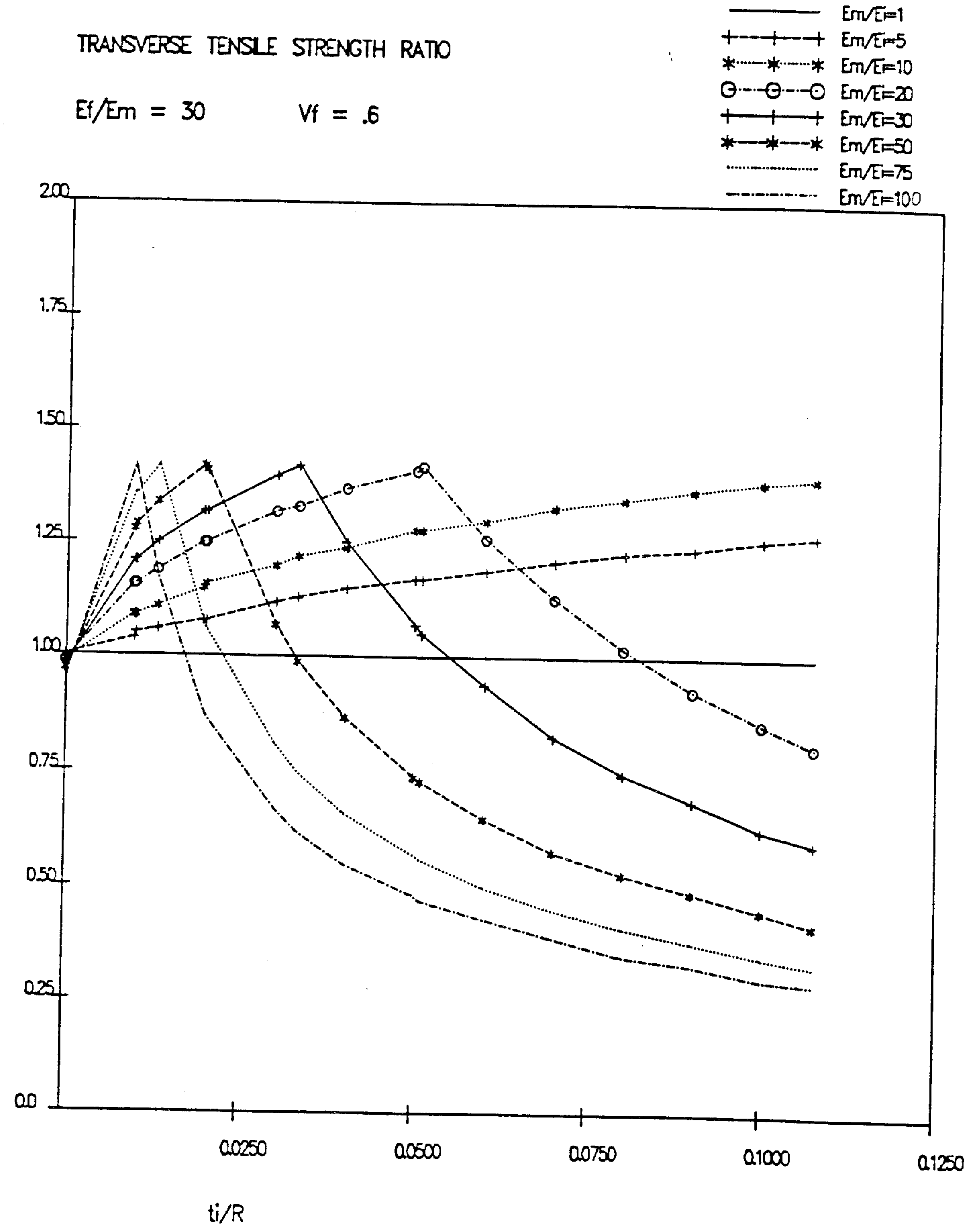
Em/Ei	ti / R 0.08	0.09	0.10
1.0	1.00	1.00	1.00
4.3	1.24	1.26	1.28
5.0	1.27	1.29	1.31
5.9	1.31	1.32	1.34
7.6	1.35	1.37	1.39
10.0	1.41	1.43	1.45
10.9	1.43	1.45	1.47
12.0	1.45	1.47	1.36
13.4	1.48	1.35	1.25
15.1	1.34	1.23	1.13
17.5	1.20	1.10	1.01
20.0	1.08	0.99	0.91
20.8	1.05	0.96	0.88
25.8	0.89	0.82	0.75
30.0	0.80	0.73	0.67
34.0	0.73	0.67	0.61
50.0	0.56	0.51	0.47
50.5	0.56	0.51	0.47
75.0	0.44	0.40	0.37
100.0	0.37	0.34	0.32
100.0	0.37	0.34	0.32
Em/Ei cr	13.38	12.00	10.90

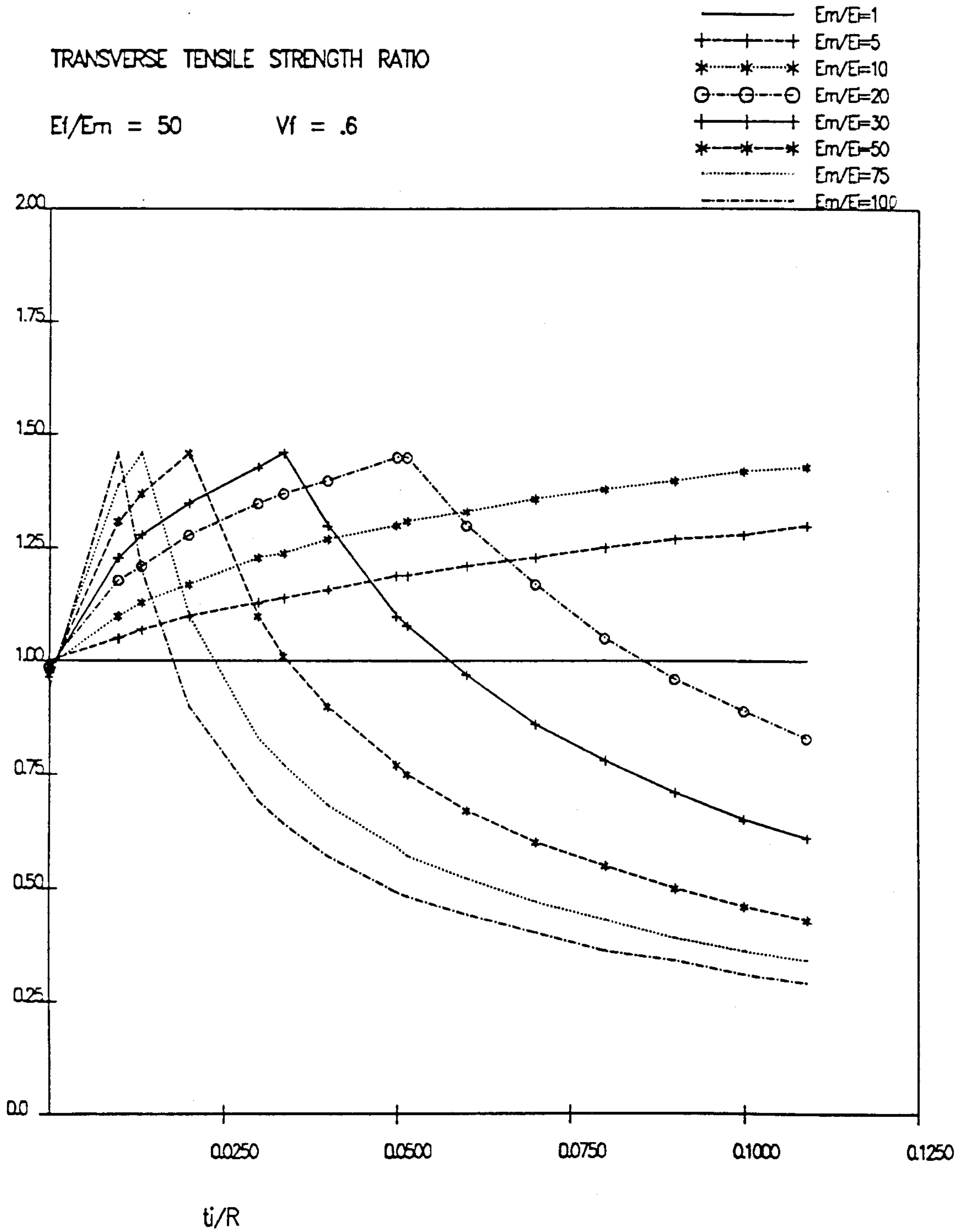

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R

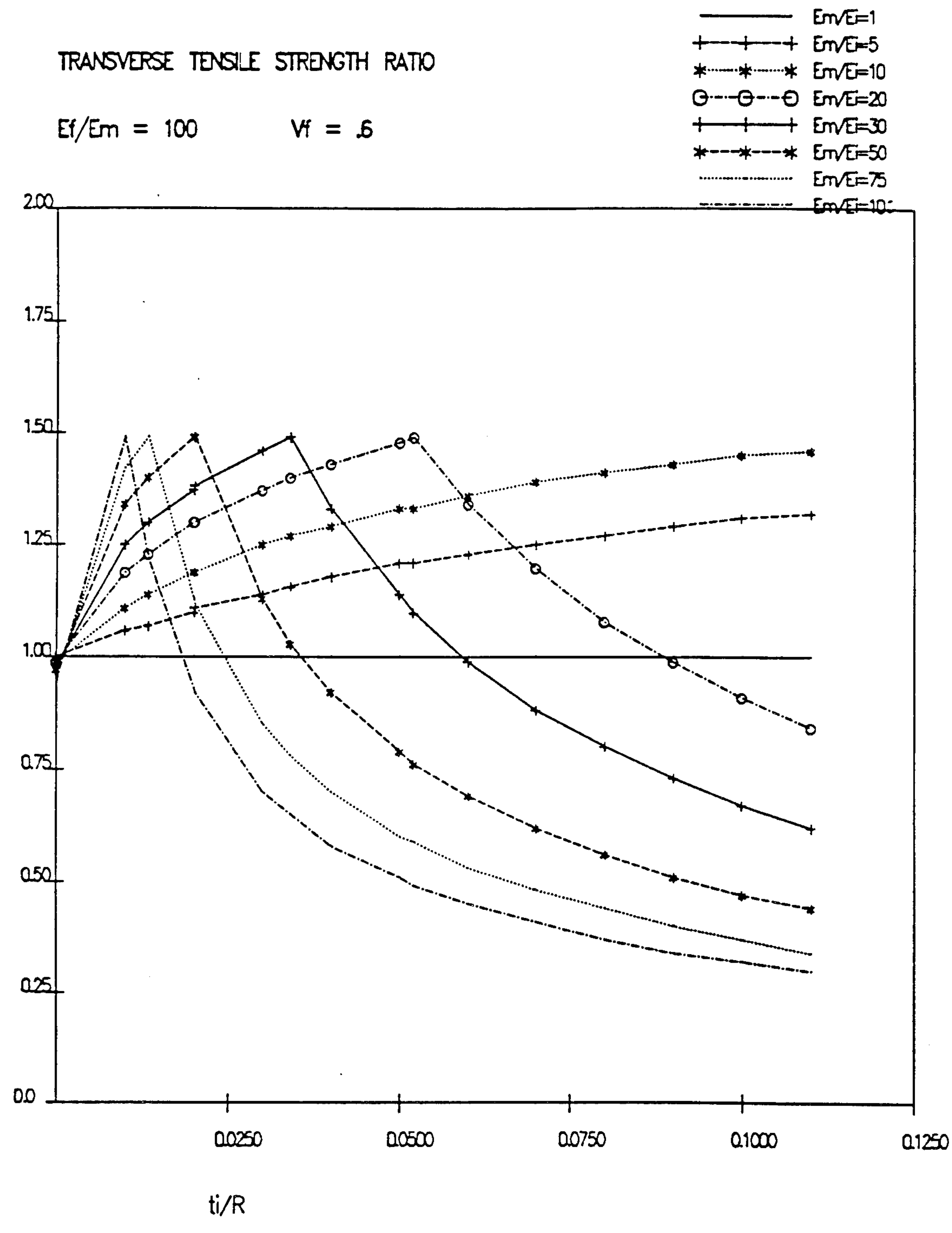

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50 Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100 Vf = .6
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0250
0.0500
0.0750
0.1000
0.1250
ti/R

tratout **Tue Dec 29 16:20:47 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.98	0.97
0.008	1.00	1.01	1.02	1.04	1.05	1.09	1.12	1.16
0.010	1.00	1.01	1.02	1.05	1.07	1.11	1.15	1.02
0.011	1.00	1.01	1.03	1.05	1.07	1.11	1.16	0.98
0.016	1.00	1.02	1.04	1.07	1.10	1.16	0.91	0.76
0.020	1.00	1.02	1.05	1.09	1.12	1.03	0.80	0.66
0.028	1.00	1.03	1.06	1.11	1.16	0.84	0.65	0.54
0.030	1.00	1.03	1.07	1.12	1.11	0.80	0.62	0.51
0.040	1.00	1.04	1.08	1.15	0.92	0.66	0.51	0.43
0.042	1.00	1.04	1.09	1.16	0.89	0.64	0.49	0.42
0.050	1.00	1.05	1.10	1.04	0.80	0.57	0.44	0.37
0.060	1.00	1.06	1.11	0.93	0.71	0.50	0.39	0.33
0.070	1.00	1.07	1.13	0.84	0.63	0.45	0.35	0.30
0.080	1.00	1.07	1.14	0.76	0.58	0.41	0.32	0.28
0.089	1.00	1.08	1.15	0.71	0.53	0.38	0.30	0.26
0.090	1.00	1.08	1.14	0.70	0.53	0.38	0.30	0.26
0.100	1.00	1.09	1.06	0.65	0.49	0.35	0.28	0.24
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout Tue Dec 29 16:20:54 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.009	1.00	1.02	1.05	1.09	1.12	1.17	1.23	1.28
0.010	1.00	1.03	1.05	1.10	1.13	1.19	1.25	1.21
0.012	1.00	1.03	1.06	1.11	1.15	1.22	1.28	1.06
0.018	1.00	1.05	1.09	1.15	1.20	1.28	0.98	0.81
0.020	1.00	1.05	1.09	1.16	1.21	1.22	0.93	0.77
0.030	1.00	1.07	1.13	1.21	1.28	0.93	0.71	0.59
0.031	1.00	1.07	1.13	1.22	1.28	0.91	0.69	0.58
0.040	1.00	1.09	1.16	1.25	1.08	0.76	0.58	0.49
0.047	1.00	1.10	1.17	1.28	0.97	0.68	0.52	0.44
0.050	1.00	1.10	1.18	1.23	0.93	0.65	0.50	0.42
0.060	1.00	1.12	1.20	1.09	0.82	0.58	0.45	0.38
0.070	1.00	1.13	1.22	0.98	0.73	0.52	0.40	0.34
0.080	1.00	1.14	1.24	0.89	0.66	0.47	0.37	0.31
0.090	1.00	1.15	1.25	0.81	0.61	0.43	0.34	0.29
0.100	1.00	1.16	1.26	0.75	0.56	0.40	0.31	0.27
0.100	1.00	1.16	1.26	0.75	0.56	0.40	0.31	0.27
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout   Tue Dec 29 16:20:59 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0   Vf = 0.60   max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95
0.010	1.00	1.04	1.08	1.13	1.18	1.25	1.32	1.38
0.010	1.00	1.04	1.08	1.14	1.18	1.26	1.33	1.34
0.013	1.00	1.05	1.10	1.17	1.22	1.30	1.38	1.14
0.019	1.00	1.07	1.13	1.22	1.28	1.38	1.05	0.86
0.020	1.00	1.07	1.14	1.22	1.29	1.35	1.02	0.84
0.030	1.00	1.10	1.18	1.28	1.36	1.03	0.78	0.64
0.033	1.00	1.11	1.19	1.30	1.38	0.96	0.73	0.61
0.040	1.00	1.13	1.22	1.33	1.20	0.84	0.64	0.53
0.050	1.00	1.15	1.25	1.37	1.03	0.72	0.55	0.46
0.050	1.00	1.15	1.25	1.37	1.03	0.72	0.55	0.46
0.060	1.00	1.17	1.27	1.21	0.90	0.63	0.49	0.41
0.070	1.00	1.19	1.30	1.08	0.80	0.56	0.44	0.37
0.080	1.00	1.20	1.32	0.98	0.73	0.51	0.40	0.34
0.090	1.00	1.22	1.33	0.90	0.66	0.47	0.37	0.32
0.100	1.00	1.23	1.35	0.83	0.61	0.43	0.34	0.29
0.106	1.00	1.23	1.36	0.79	0.59	0.41	0.33	0.28
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout   Tue Dec 29 16:21:06 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0   Vf = 0.60   max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.95
0.010	1.00	1.04	1.08	1.15	1.19	1.27	1.34	1.40
0.010	1.00	1.04	1.09	1.15	1.20	1.27	1.35	1.37
0.013	1.00	1.05	1.11	1.18	1.24	1.32	1.41	1.15
0.020	1.00	1.08	1.15	1.24	1.30	1.41	1.06	0.87
0.020	1.00	1.08	1.15	1.24	1.31	1.39	1.05	0.86
0.030	1.00	1.11	1.19	1.30	1.38	1.05	0.79	0.66
0.033	1.00	1.12	1.21	1.32	1.40	0.98	0.74	0.62
0.040	1.00	1.14	1.23	1.35	1.23	0.86	0.65	0.54
0.050	1.00	1.16	1.26	1.40	1.05	0.73	0.56	0.47
0.051	1.00	1.16	1.27	1.40	1.04	0.73	0.56	0.47
0.060	1.00	1.18	1.29	1.24	0.92	0.64	0.50	0.42
0.070	1.00	1.20	1.32	1.11	0.82	0.58	0.45	0.38
0.080	1.00	1.22	1.34	1.00	0.74	0.52	0.41	0.35
0.090	1.00	1.23	1.35	0.92	0.68	0.48	0.37	0.32
0.100	1.00	1.24	1.37	0.85	0.63	0.44	0.35	0.30
0.107	1.00	1.25	1.38	0.80	0.59	0.42	0.33	0.28
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout Tue Dec 29 16:21:10 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.95
0.010	1.00	1.04	1.09	1.16	1.21	1.28	1.36	1.42
0.010	1.00	1.05	1.09	1.16	1.21	1.29	1.36	1.40
0.013	1.00	1.06	1.11	1.19	1.25	1.34	1.42	1.17
0.020	1.00	1.08	1.15	1.25	1.32	1.42	1.07	0.88
0.020	1.00	1.08	1.16	1.25	1.32	1.41	1.06	0.87
0.030	1.00	1.12	1.20	1.32	1.40	1.07	0.81	0.67
0.033	1.00	1.13	1.22	1.33	1.42	0.99	0.75	0.62
0.040	1.00	1.15	1.24	1.37	1.25	0.87	0.66	0.55
0.050	1.00	1.17	1.28	1.41	1.07	0.74	0.57	0.48
0.051	1.00	1.17	1.28	1.42	1.05	0.73	0.56	0.47
0.060	1.00	1.19	1.30	1.26	0.94	0.65	0.50	0.43
0.070	1.00	1.21	1.33	1.13	0.83	0.58	0.45	0.39
0.080	1.00	1.23	1.35	1.02	0.75	0.53	0.41	0.35
0.090	1.00	1.24	1.37	0.93	0.69	0.49	0.38	0.33
0.100	1.00	1.26	1.39	0.86	0.63	0.45	0.35	0.30
0.107	1.00	1.27	1.40	0.81	0.60	0.42	0.33	0.29
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout Tue Dec 29 16:21:15 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.60 max ti/R = 0.144

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.96	0.94
0.010	1.00	1.05	1.10	1.18	1.23	1.31	1.39	1.46
0.010	1.00	1.05	1.10	1.18	1.23	1.31	1.39	1.45
0.013	1.00	1.07	1.13	1.21	1.28	1.37	1.46	1.20
0.020	1.00	1.10	1.17	1.28	1.35	1.46	1.10	0.90
0.020	1.00	1.10	1.17	1.28	1.35	1.46	1.10	0.90
0.030	1.00	1.13	1.23	1.35	1.43	1.10	0.83	0.69
0.034	1.00	1.14	1.24	1.37	1.46	1.01	0.77	0.64
0.040	1.00	1.16	1.27	1.40	1.30	0.90	0.68	0.57
0.050	1.00	1.19	1.30	1.45	1.10	0.77	0.59	0.49
0.052	1.00	1.19	1.31	1.45	1.08	0.75	0.57	0.48
0.060	1.00	1.21	1.33	1.30	0.97	0.67	0.52	0.44
0.070	1.00	1.23	1.36	1.17	0.86	0.60	0.47	0.40
0.080	1.00	1.25	1.38	1.05	0.78	0.55	0.43	0.36
0.090	1.00	1.27	1.40	0.96	0.71	0.50	0.39	0.34
0.100	1.00	1.28	1.42	0.89	0.65	0.46	0.36	0.31
0.109	1.00	1.30	1.43	0.83	0.61	0.43	0.34	0.29
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Tue Dec 29 16:21:19 1992 1

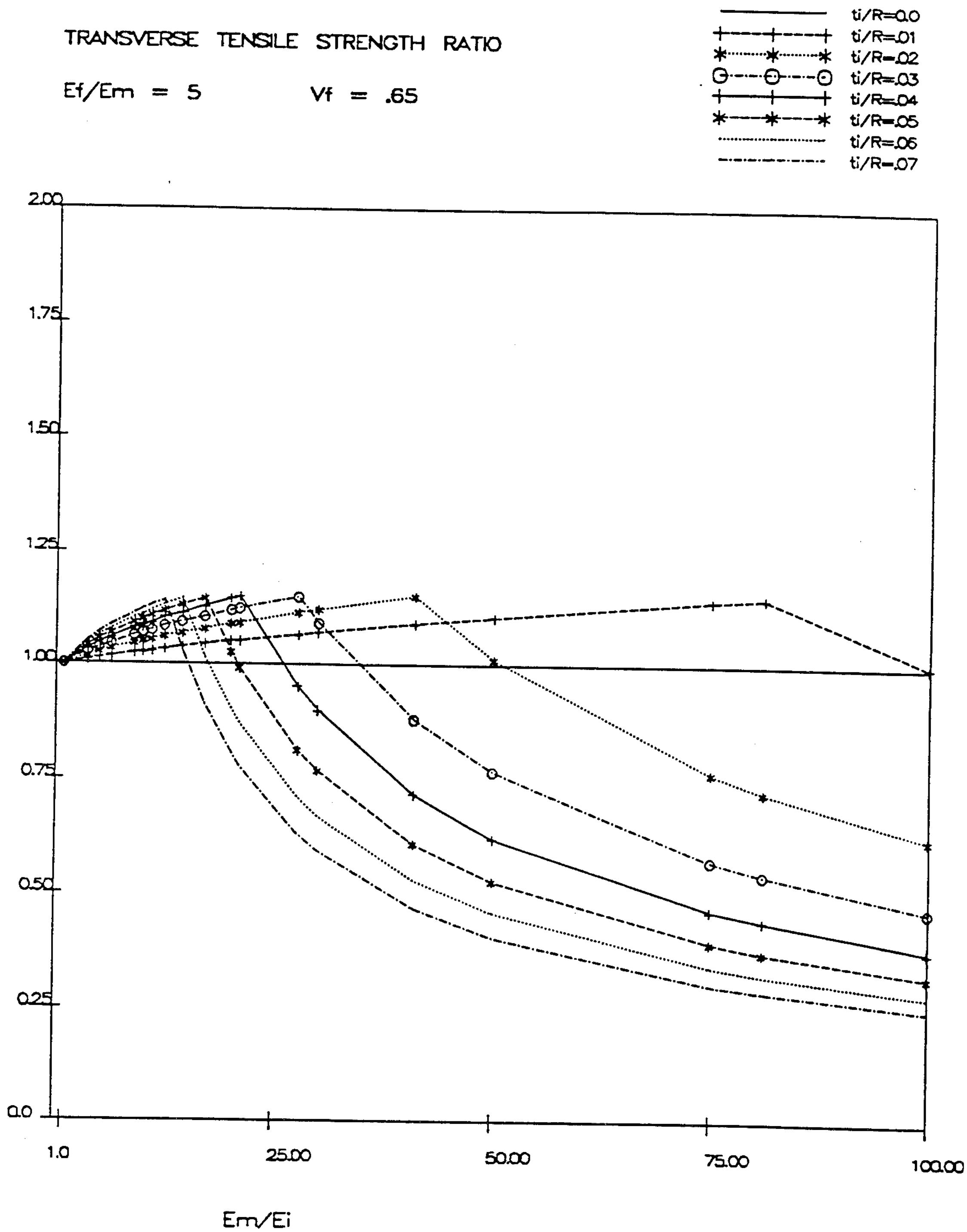
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

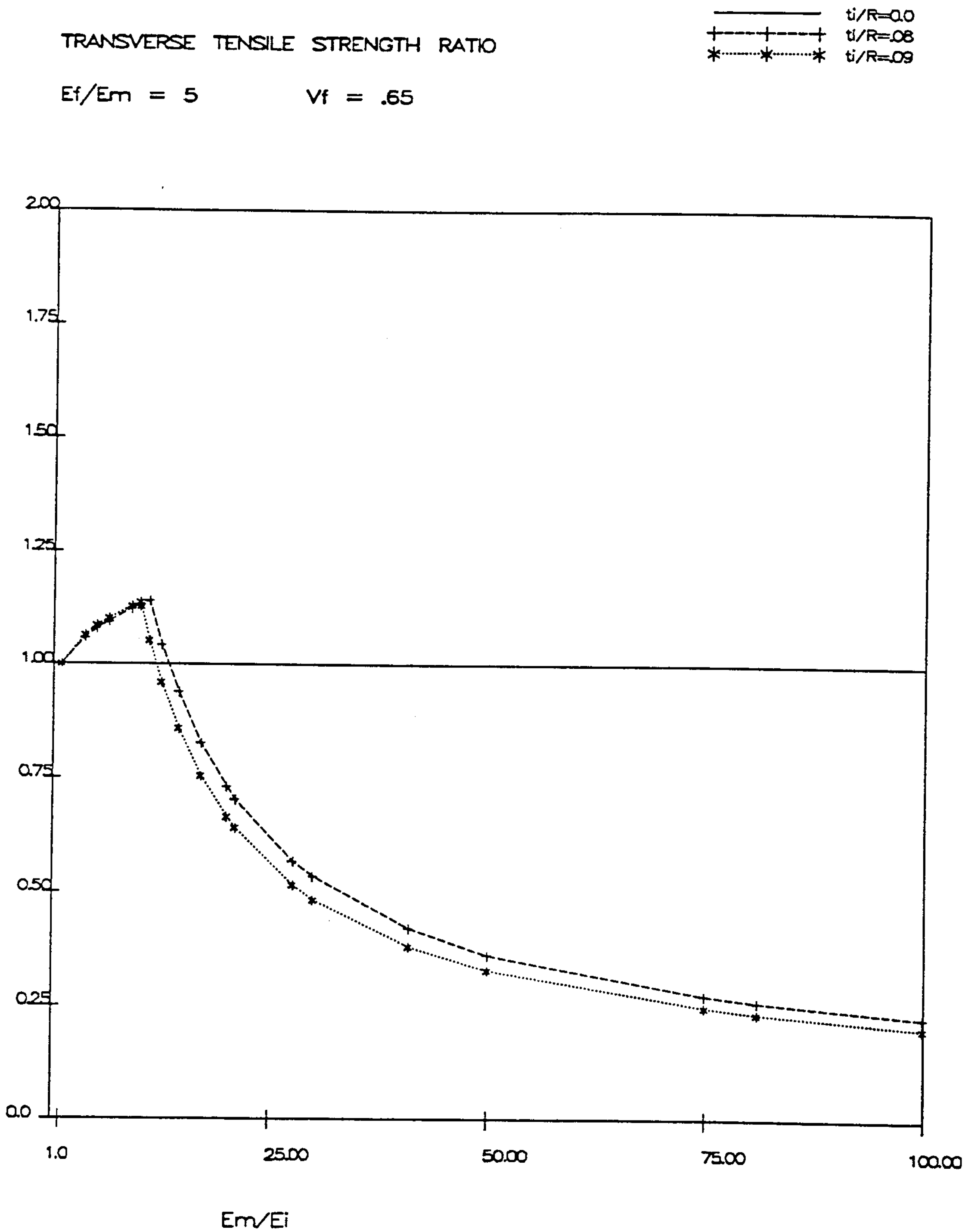
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em =100.0 Vf = 0.60 max ti/R = 0.144

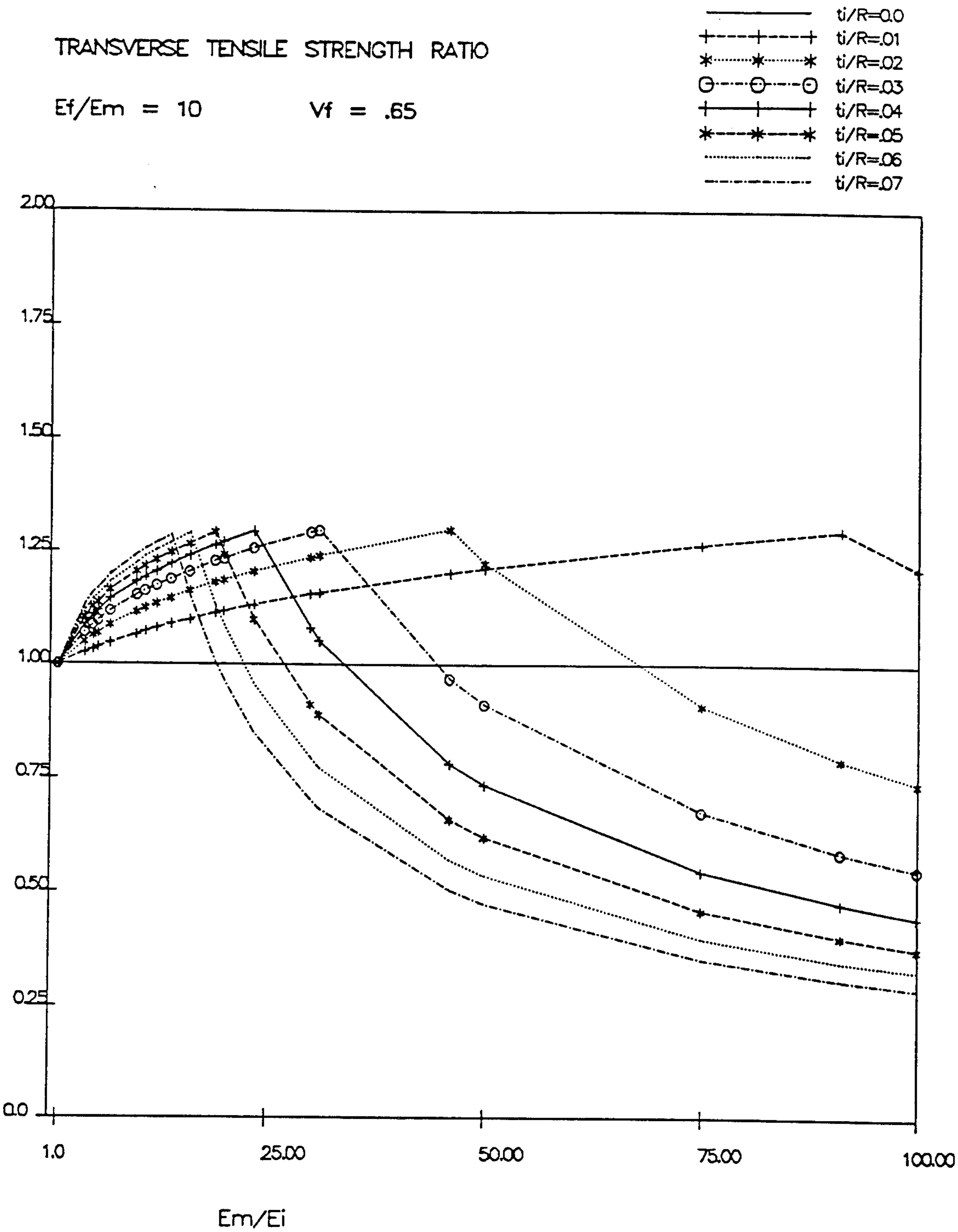
TRANSVERSE TENSILE STRENGTH RATIO

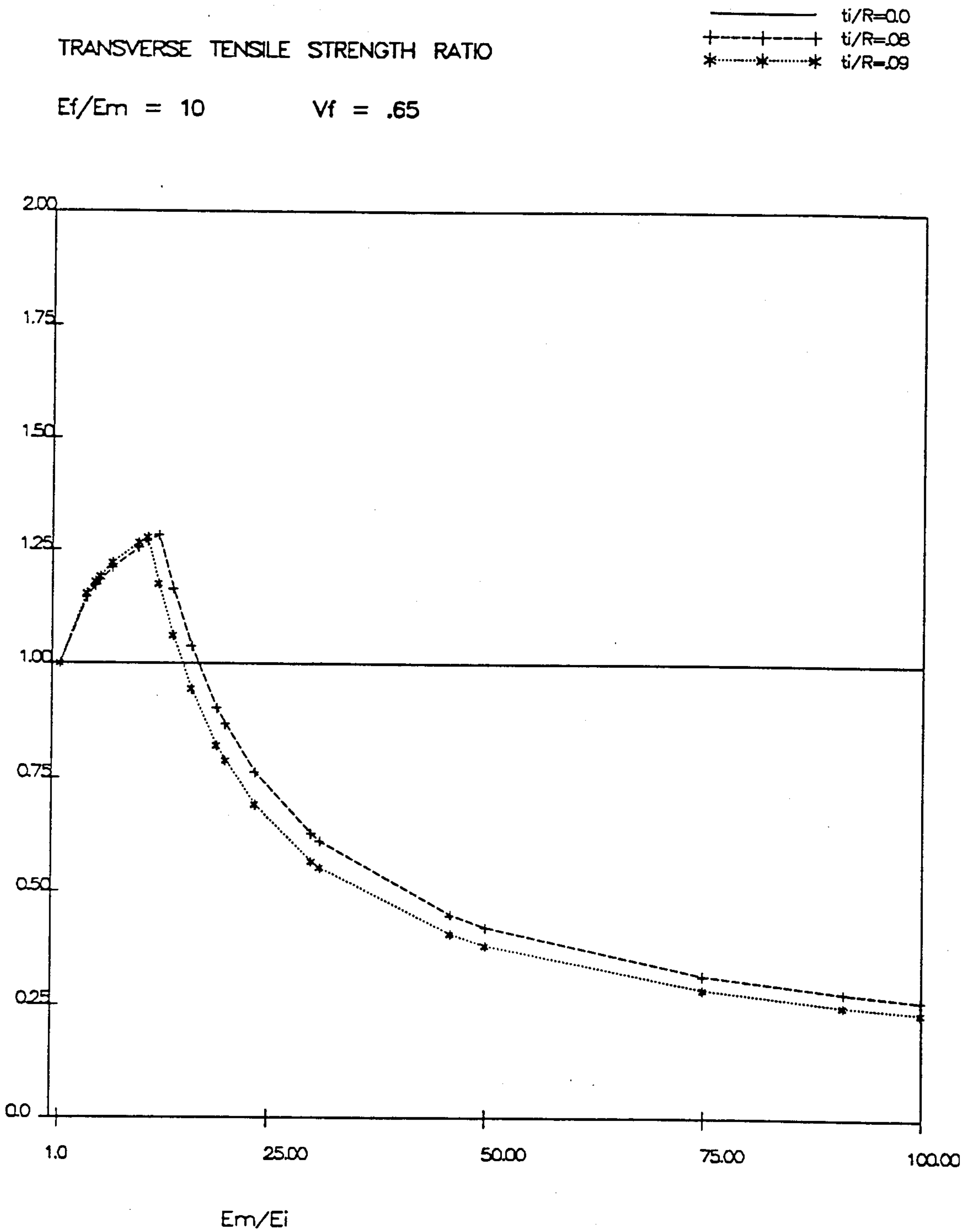
	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.95	0.94
0.010	1.00	1.06	1.11	1.19	1.25	1.34	1.42	1.49
0.010	1.00	1.06	1.11	1.19	1.25	1.34	1.42	1.49
0.013	1.00	1.07	1.14	1.23	1.30	1.40	1.49	1.22
0.020	1.00	1.10	1.19	1.30	1.37	1.49	1.13	0.93
0.020	1.00	1.11	1.19	1.30	1.38	1.49	1.12	0.92
0.030	1.00	1.14	1.25	1.37	1.46	1.13	0.85	0.70
0.034	1.00	1.16	1.27	1.40	1.49	1.03	0.78	0.65
0.040	1.00	1.18	1.29	1.43	1.33	0.92	0.70	0.58
0.050	1.00	1.21	1.33	1.48	1.14	0.79	0.60	0.51
0.052	1.00	1.21	1.33	1.49	1.10	0.76	0.59	0.49
0.060	1.00	1.23	1.36	1.34	0.99	0.69	0.53	0.45
0.070	1.00	1.25	1.39	1.20	0.88	0.62	0.48	0.41
0.080	1.00	1.27	1.41	1.08	0.80	0.56	0.44	0.37
0.090	1.00	1.29	1.43	0.99	0.73	0.51	0.40	0.34
0.100	1.00	1.31	1.45	0.91	0.67	0.47	0.37	0.32
0.110	1.00	1.32	1.46	0.84	0.62	0.44	0.34	0.30
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010

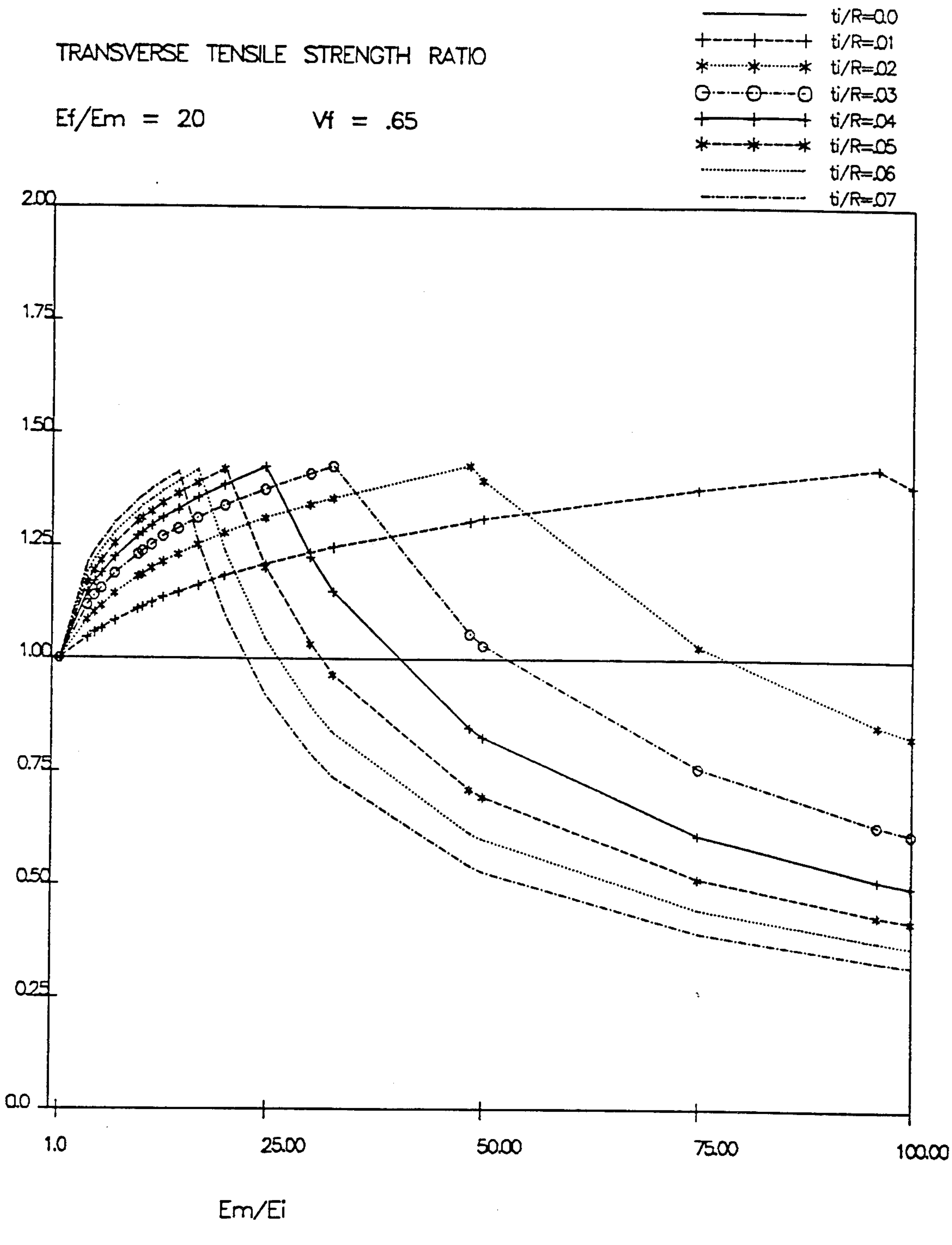

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

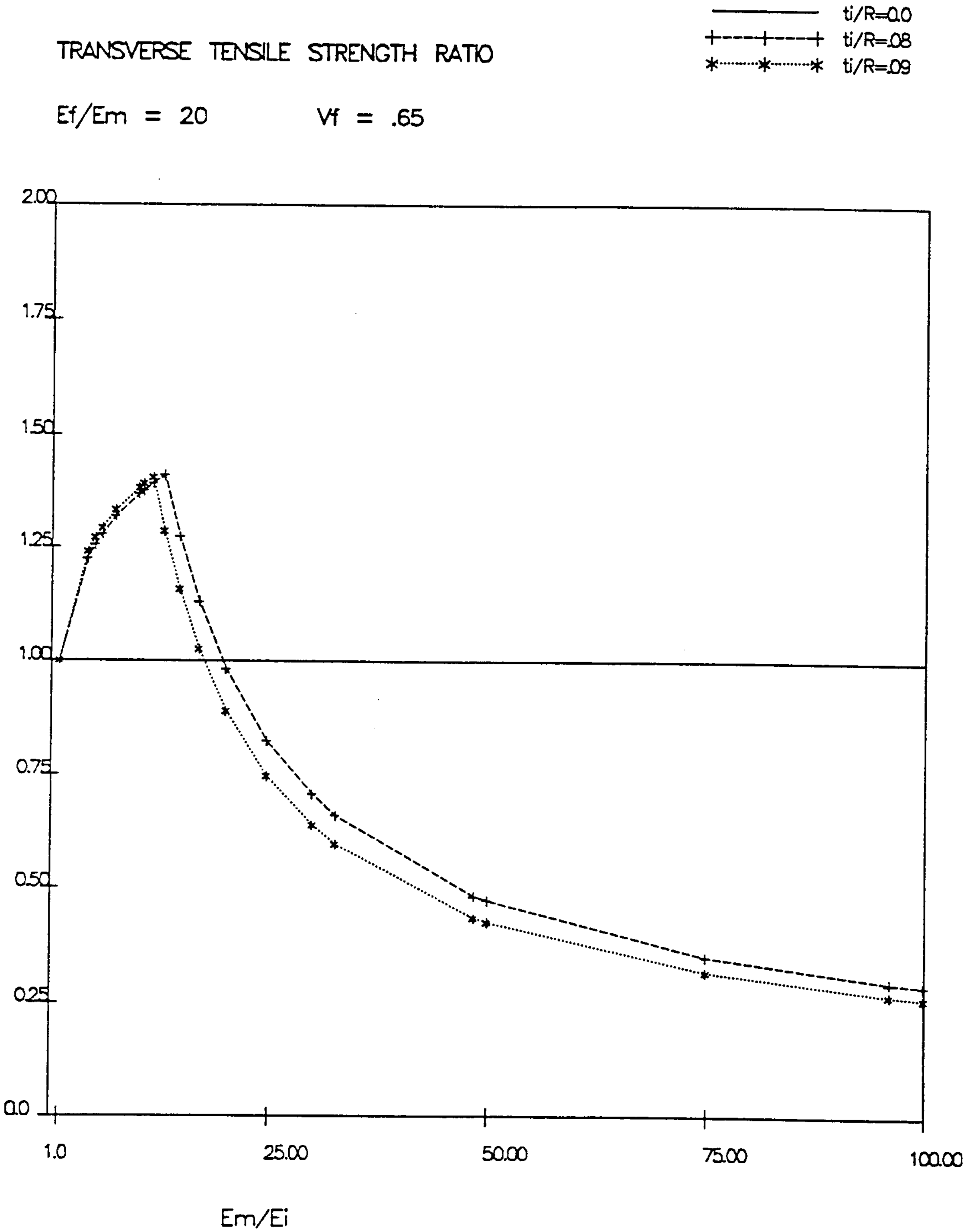


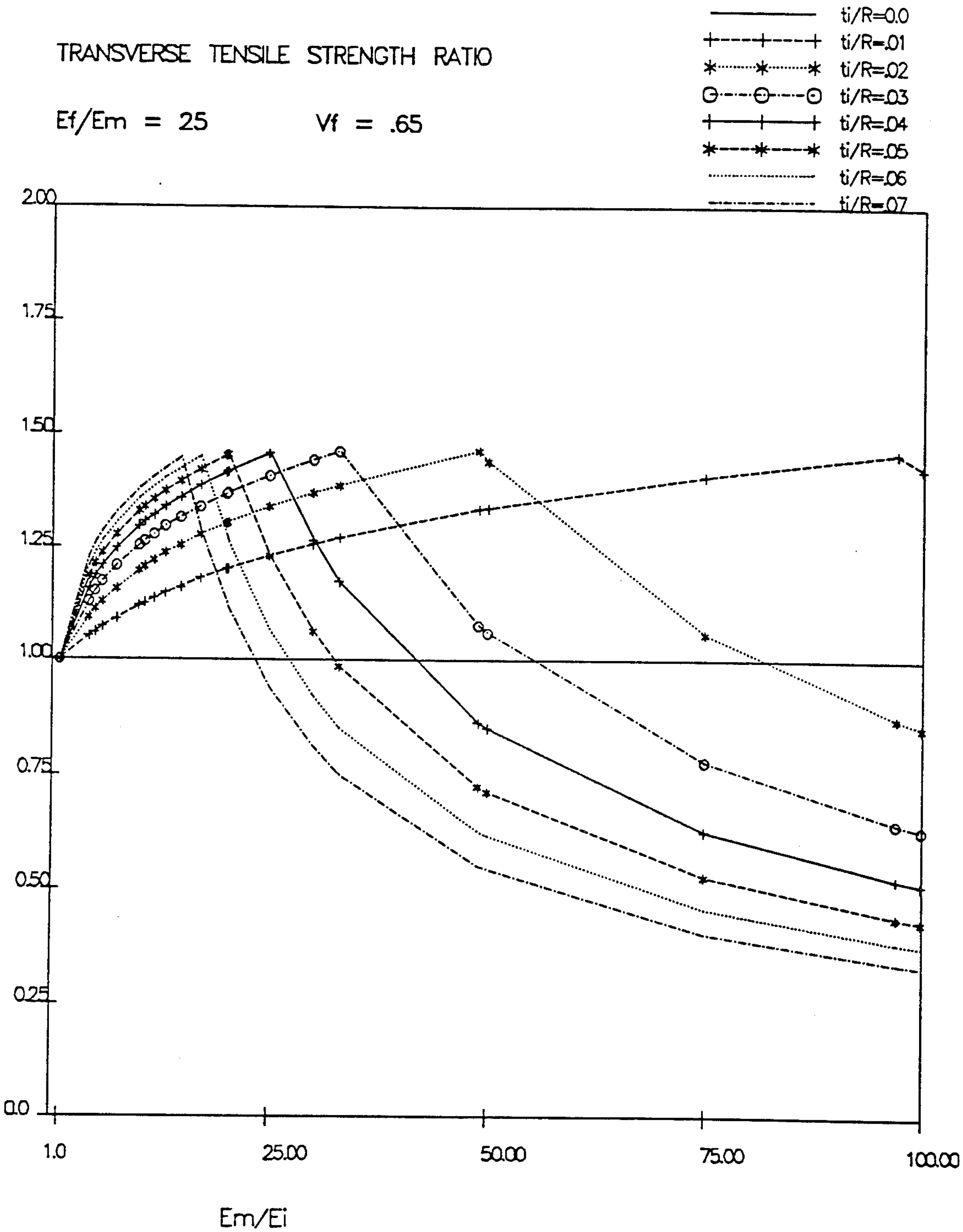
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5
Vf = .65
ti/R=0.0
ti/R=.08
ti/R=.09
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

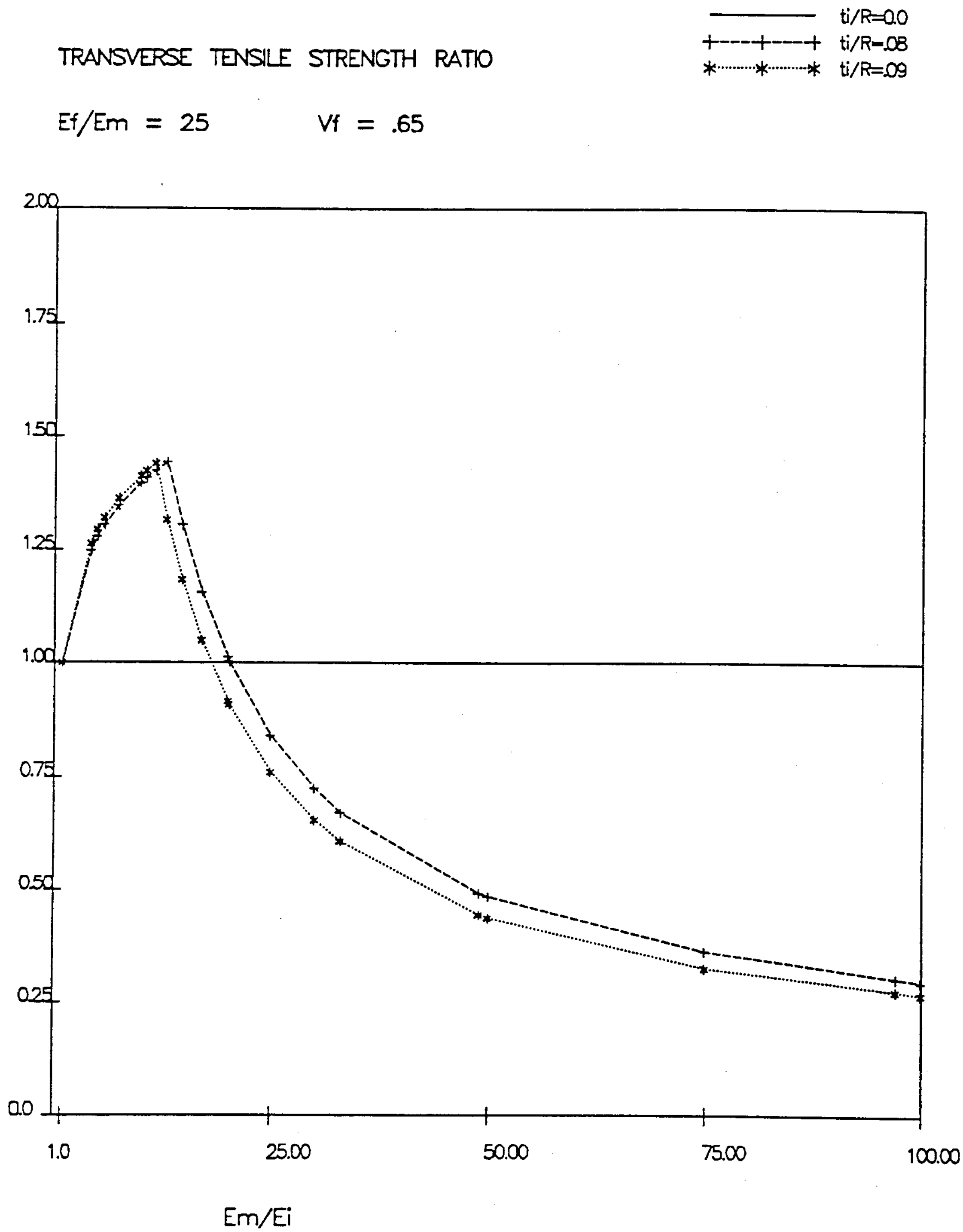

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


ti/R=0.0
ti/R=.08
ti/R=.09
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .65
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

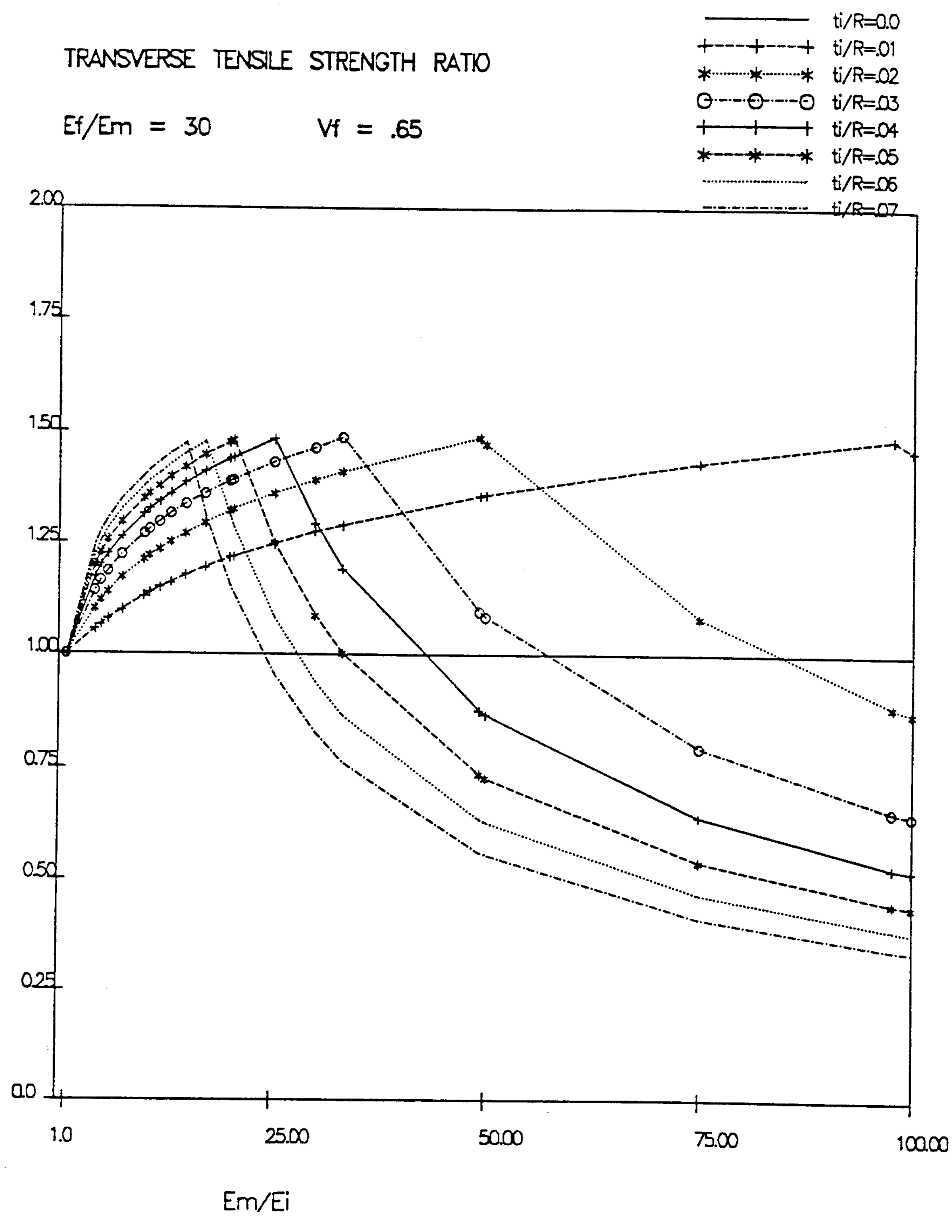

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

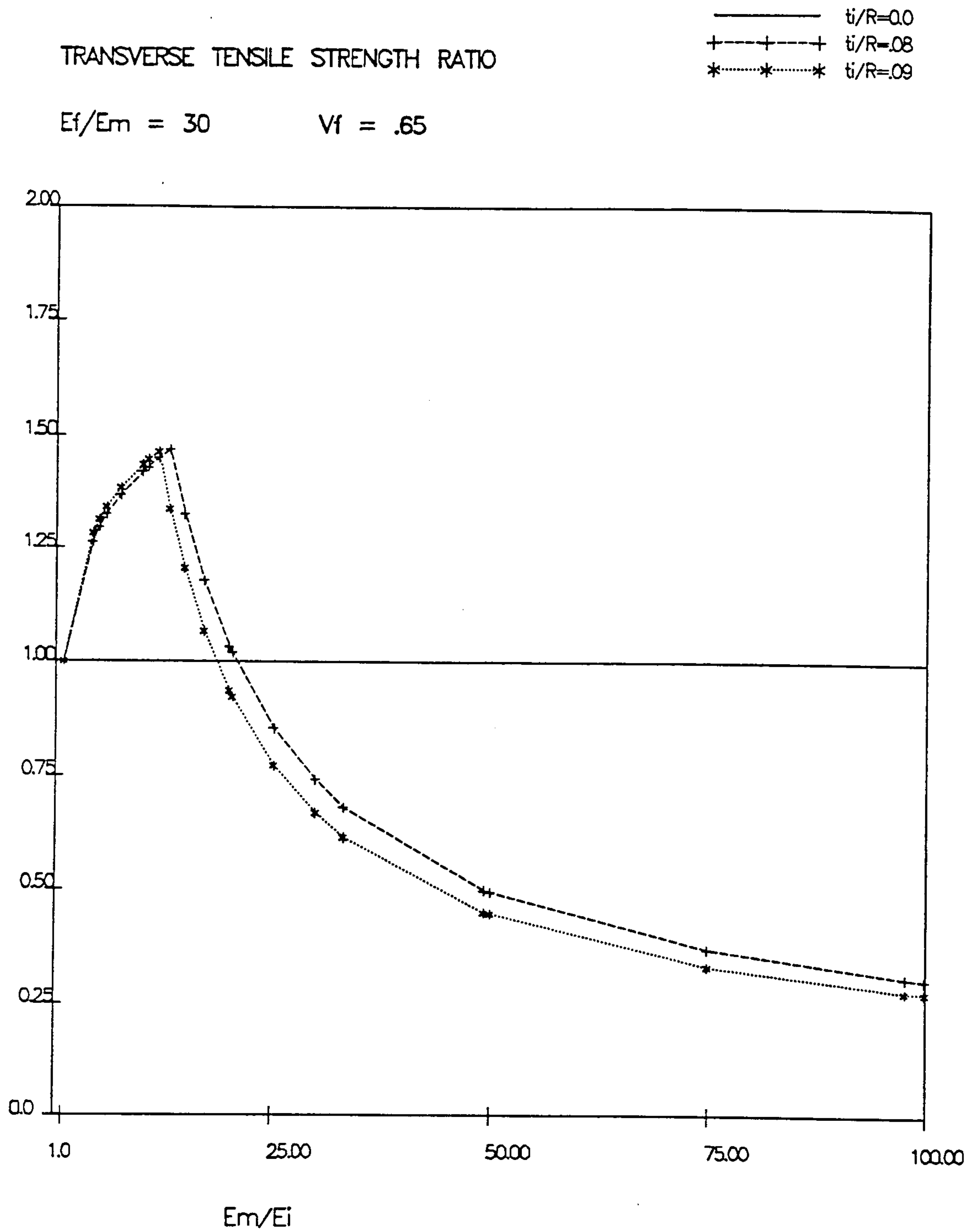

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20 Vf = .65
ti/R=0.0
ti/R=.08
ti/R=.09
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

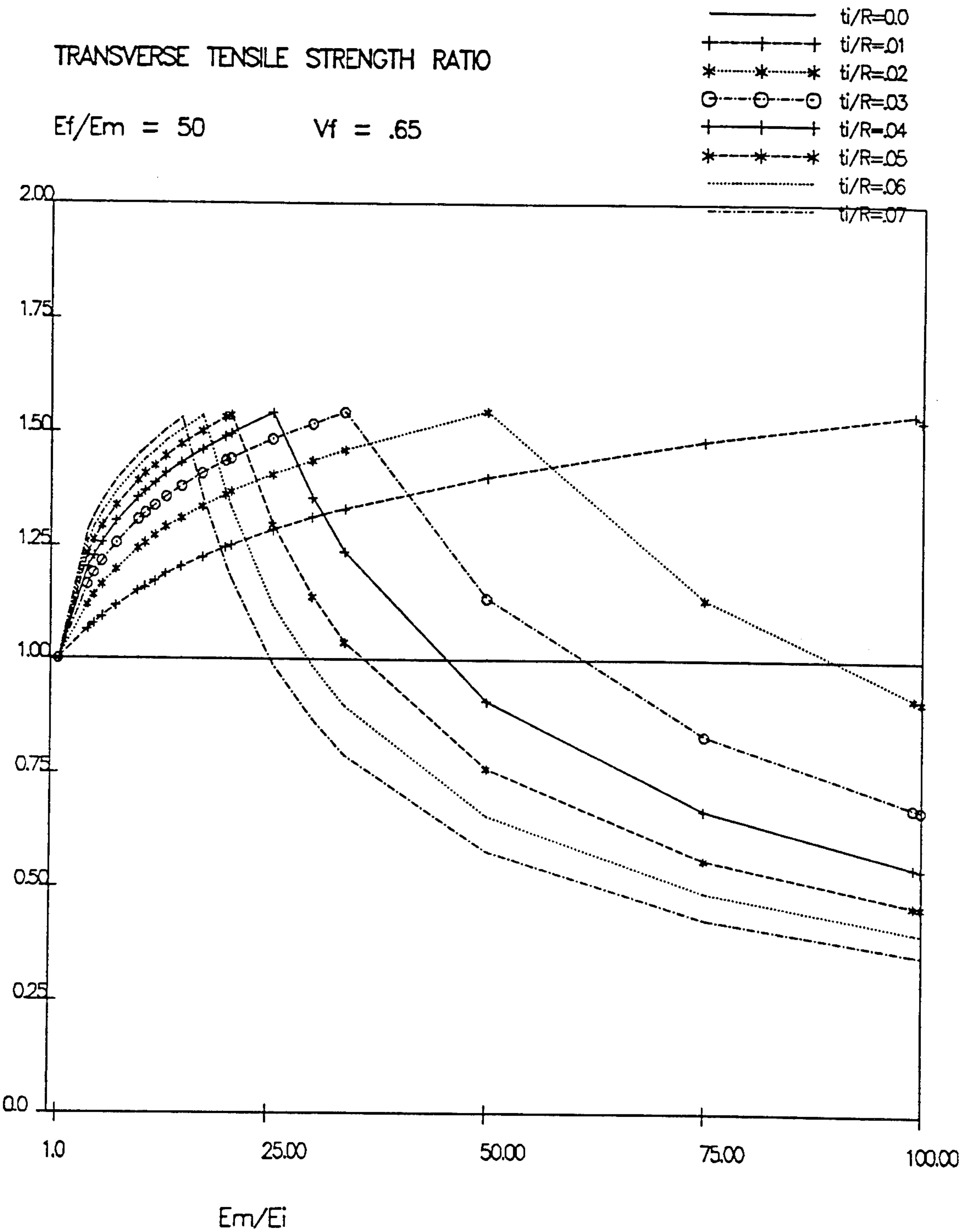


ti/R=0.0
ti/R=.08
ti/R=.09
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .65
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

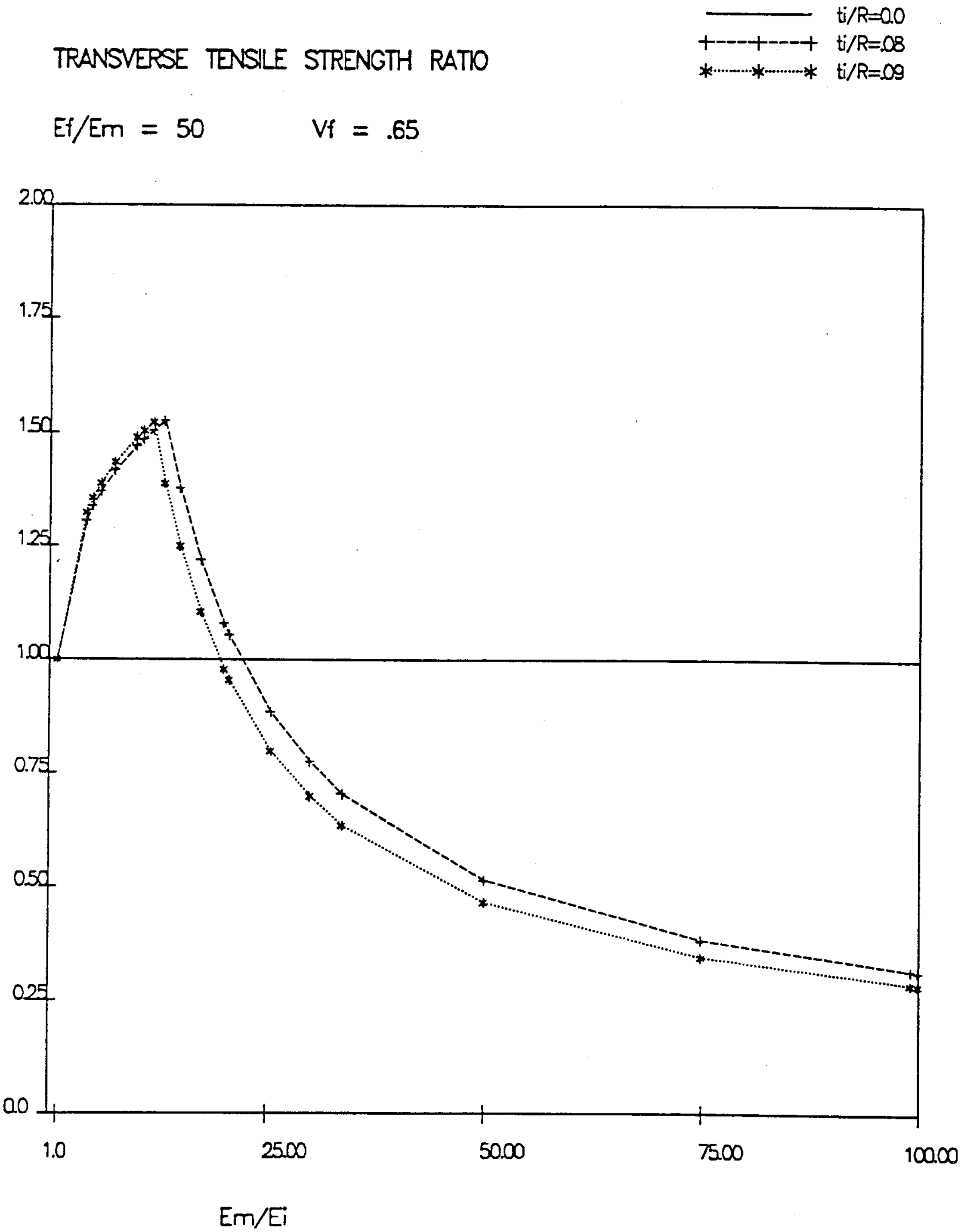

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

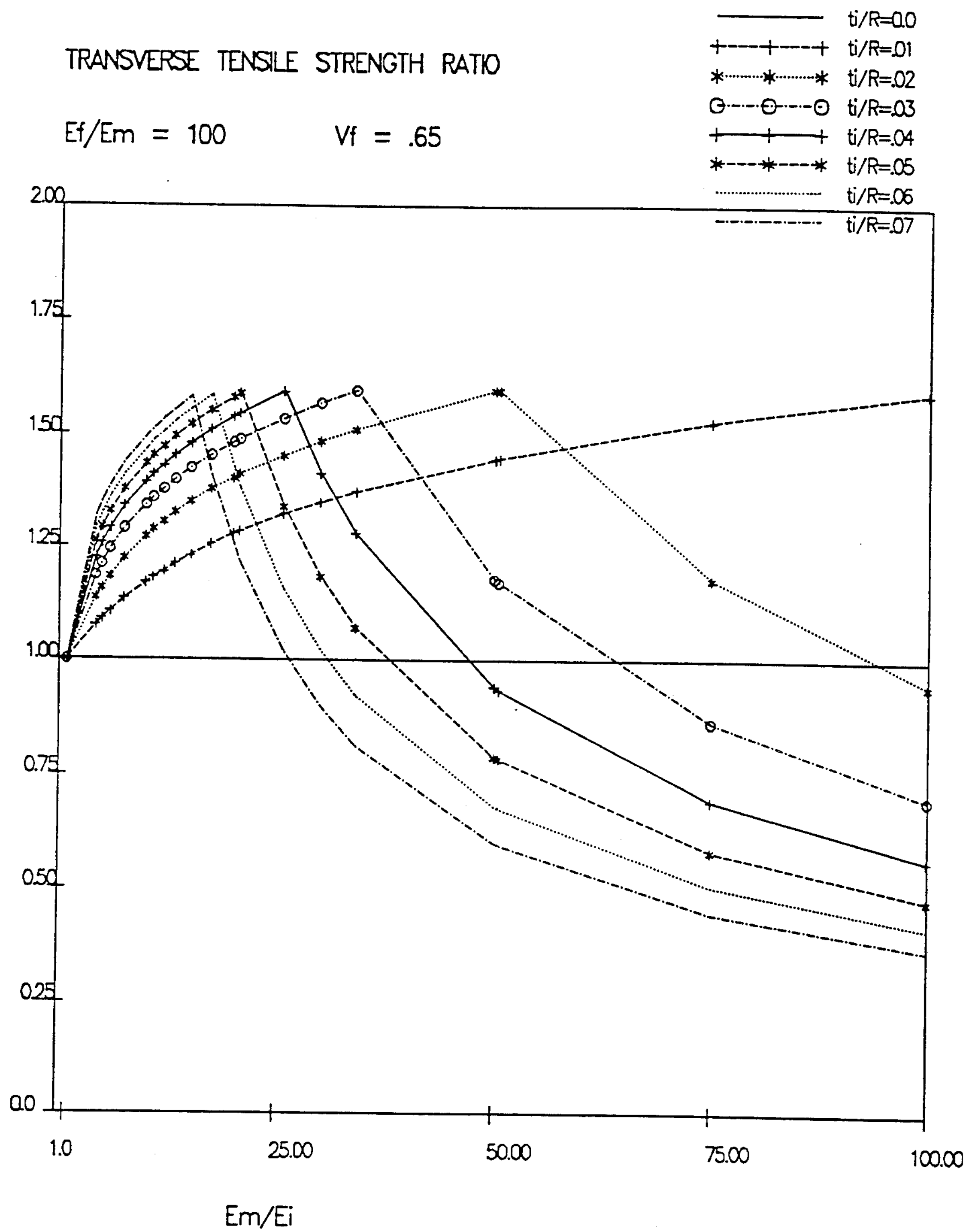


ti/R=0.0
ti/R=.08
ti/R=.09
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .65
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

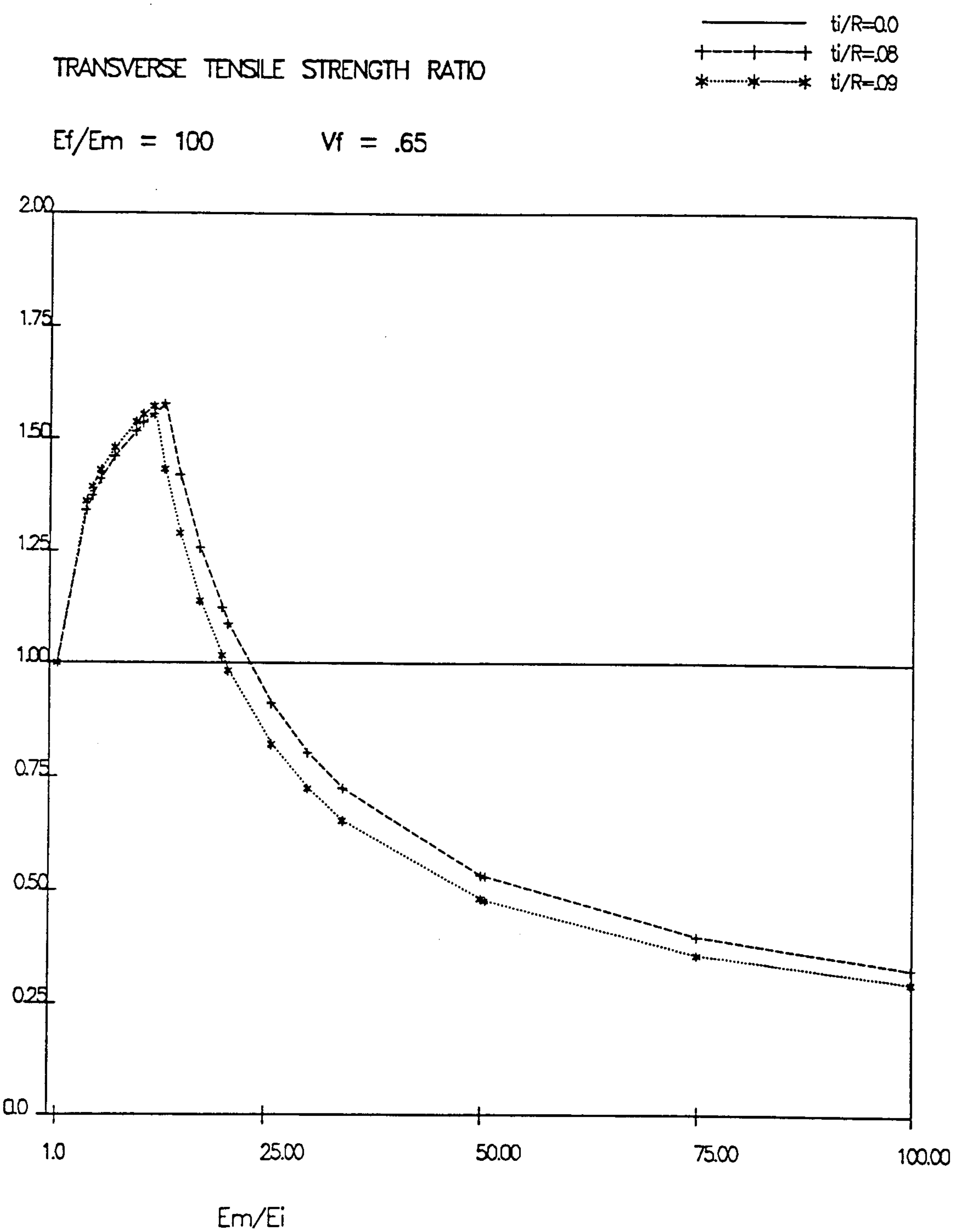


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


ti/R=0.0
ti/R=.08
ti/R=.09
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .65
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .65
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
ti/R=.06
ti/R=.07
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100 Vf = .65
ti/R=0.0
ti/R=.08
ti/R=.09
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

tratout Fri Dec 18 12:48:33 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
3.7	1.00	1.01	1.02	1.03	1.03	1.04	1.05	1.05
5.0	1.00	1.01	1.03	1.04	1.05	1.06	1.07	1.07
5.0	1.00	1.01	1.03	1.04	1.05	1.06	1.07	1.07
6.3	1.00	1.02	1.03	1.05	1.06	1.07	1.08	1.09
9.0	1.00	1.02	1.05	1.07	1.08	1.09	1.11	1.11
9.9	1.00	1.03	1.05	1.07	1.09	1.10	1.11	1.12
10.0	1.00	1.03	1.05	1.07	1.09	1.10	1.11	1.12
11.0	1.00	1.03	1.06	1.08	1.09	1.11	1.12	1.13
12.4	1.00	1.03	1.06	1.08	1.10	1.12	1.13	1.14
14.3	1.00	1.04	1.07	1.09	1.11	1.13	1.15	1.03
17.0	1.00	1.04	1.08	1.11	1.13	1.15	1.02	0.91
20.0	1.00	1.05	1.09	1.12	1.15	1.03	0.90	0.81
21.0	1.00	1.05	1.09	1.13	1.15	0.99	0.87	0.78
27.7	1.00	1.07	1.12	1.15	0.95	0.81	0.71	0.63
30.0	1.00	1.07	1.12	1.09	0.90	0.77	0.67	0.59
41.0	1.00	1.09	1.15	0.88	0.72	0.61	0.53	0.47
50.0	1.00	1.11	1.01	0.77	0.62	0.53	0.46	0.41
75.0	1.00	1.14	0.77	0.57	0.47	0.40	0.34	0.30
81.0	1.00	1.15	0.73	0.54	0.44	0.37	0.33	0.29
100.0	1.00	1.00	0.63	0.47	0.38	0.33	0.28	0.25
Em/Ei cr		81.00	41.00	27.67	21.00	17.00	14.33	12.43

Em/Ei	ti / R = 0.08	0.09
1.0	1.00	1.00
3.7	1.06	1.06
5.0	1.08	1.08
5.0	1.08	1.08
6.3	1.10	1.10
9.0	1.12	1.13
9.9	1.13	1.14
10.0	1.13	1.13
11.0	1.14	1.05
12.4	1.04	0.96
14.3	0.94	0.86
17.0	0.83	0.75
20.0	0.73	0.66
21.0	0.70	0.64
27.7	0.57	0.52
30.0	0.53	0.48
41.0	0.42	0.38
50.0	0.36	0.33
75.0	0.27	0.25
81.0	0.26	0.23
100.0	0.23	0.20
Em/Ei cr	11.00	9.89

tratout Fri Dec 18 12:48:40 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.0	1.00	1.03	1.05	1.07	1.09	1.11	1.12	1.13
5.0	1.00	1.03	1.06	1.09	1.11	1.13	1.14	1.16
5.5	1.00	1.04	1.07	1.10	1.12	1.14	1.15	1.17
7.0	1.00	1.05	1.09	1.12	1.14	1.16	1.18	1.20
10.0	1.00	1.07	1.12	1.15	1.18	1.21	1.23	1.24
10.0	1.00	1.07	1.12	1.15	1.18	1.21	1.23	1.24
11.0	1.00	1.07	1.13	1.16	1.19	1.22	1.24	1.25
12.2	1.00	1.08	1.14	1.18	1.21	1.23	1.25	1.27
13.9	1.00	1.09	1.15	1.19	1.22	1.25	1.27	1.29
16.0	1.00	1.10	1.16	1.21	1.24	1.27	1.29	1.15
19.0	1.00	1.11	1.18	1.23	1.26	1.29	1.13	1.01
20.0	1.00	1.12	1.19	1.24	1.27	1.24	1.09	0.97
23.5	1.00	1.13	1.21	1.26	1.30	1.10	0.96	0.85
30.0	1.00	1.16	1.24	1.29	1.08	0.91	0.79	0.70
31.0	1.00	1.16	1.24	1.30	1.05	0.89	0.77	0.68
46.0	1.00	1.20	1.30	0.97	0.78	0.66	0.57	0.50
50.0	1.00	1.21	1.22	0.91	0.74	0.62	0.54	0.47
75.0	1.00	1.27	0.91	0.68	0.55	0.46	0.40	0.35
91.0	1.00	1.30	0.79	0.59	0.48	0.40	0.35	0.31
100.0	1.00	1.21	0.74	0.55	0.44	0.38	0.33	0.29
Em/Ei cr		91.00	46.00	31.00	23.50	19.00	16.00	13.86

Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.0	1.14	1.15
5.0	1.17	1.18
5.5	1.18	1.19
7.0	1.21	1.22
10.0	1.26	1.27
10.0	1.26	1.27
11.0	1.27	1.28
12.2	1.28	1.17
13.9	1.16	1.06
16.0	1.04	0.95
19.0	0.91	0.82
20.0	0.87	0.79
23.5	0.76	0.69
30.0	0.63	0.57
31.0	0.61	0.55
46.0	0.45	0.41
50.0	0.42	0.38
75.0	0.32	0.29
91.0	0.28	0.25
100.0	0.26	0.24
Em/Ei cr	12.25	11.00

tratout   Fri Dec 18 12:48:45 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0   Vf = 0.65   max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.05	1.09	1.12	1.15	1.17	1.19	1.21
5.0	1.00	1.06	1.10	1.14	1.17	1.20	1.22	1.24
5.8	1.00	1.07	1.12	1.16	1.19	1.22	1.24	1.26
7.3	1.00	1.08	1.14	1.19	1.23	1.26	1.28	1.30
10.0	1.00	1.11	1.18	1.23	1.27	1.30	1.33	1.35
10.5	1.00	1.11	1.19	1.24	1.28	1.31	1.34	1.36
11.6	1.00	1.12	1.20	1.25	1.29	1.33	1.35	1.37
12.9	1.00	1.13	1.22	1.27	1.31	1.34	1.37	1.39
14.6	1.00	1.15	1.23	1.29	1.33	1.37	1.39	1.41
16.8	1.00	1.16	1.25	1.31	1.36	1.39	1.42	1.26
20.0	1.00	1.18	1.28	1.34	1.39	1.42	1.24	1.10
20.0	1.00	1.18	1.28	1.34	1.39	1.42	1.24	1.10
24.8	1.00	1.21	1.31	1.38	1.42	1.20	1.04	0.92
30.0	1.00	1.24	1.34	1.41	1.23	1.03	0.89	0.79
32.7	1.00	1.25	1.36	1.43	1.15	0.97	0.84	0.74
48.5	1.00	1.31	1.43	1.06	0.85	0.71	0.61	0.54
50.0	1.00	1.31	1.40	1.03	0.83	0.69	0.60	0.53
75.0	1.00	1.38	1.03	0.76	0.61	0.51	0.45	0.39
96.0	1.00	1.43	0.86	0.63	0.51	0.43	0.38	0.33
100.0	1.00	1.38	0.83	0.61	0.50	0.42	0.37	0.32
Em/Ei cr		96.00	48.50	32.67	24.75	20.00	16.83	14.57

Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.2	1.23	1.24
5.0	1.26	1.27
5.8	1.28	1.29
7.3	1.32	1.33
10.0	1.37	1.38
10.5	1.38	1.39
11.6	1.39	1.41
12.9	1.41	1.29
14.6	1.27	1.16
16.8	1.13	1.03
20.0	0.98	0.89
20.0	0.98	0.89
24.8	0.83	0.75
30.0	0.71	0.64
32.7	0.66	0.60
48.5	0.48	0.44
50.0	0.47	0.43
75.0	0.35	0.32
96.0	0.30	0.27
100.0	0.29	0.26
Em/Ei cr	12.88	11.56

tratout Fri Dec 18 12:48:50 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.05	1.10	1.13	1.16	1.19	1.21	1.23
5.0	1.00	1.06	1.11	1.15	1.19	1.22	1.24	1.26
5.8	1.00	1.07	1.13	1.17	1.21	1.24	1.27	1.29
7.4	1.00	1.09	1.16	1.21	1.25	1.28	1.31	1.33
10.0	1.00	1.12	1.20	1.26	1.30	1.33	1.36	1.38
10.6	1.00	1.13	1.21	1.26	1.31	1.34	1.37	1.39
11.7	1.00	1.14	1.22	1.28	1.32	1.36	1.38	1.41
13.0	1.00	1.15	1.24	1.30	1.34	1.38	1.40	1.43
14.7	1.00	1.16	1.26	1.32	1.36	1.40	1.43	1.45
17.0	1.00	1.18	1.28	1.34	1.39	1.42	1.45	1.29
20.0	1.00	1.20	1.30	1.37	1.42	1.45	1.28	1.13
20.2	1.00	1.20	1.31	1.37	1.42	1.46	1.27	1.12
25.0	1.00	1.23	1.34	1.41	1.46	1.23	1.07	0.94
30.0	1.00	1.26	1.37	1.44	1.27	1.07	0.92	0.81
33.0	1.00	1.27	1.39	1.46	1.18	0.99	0.85	0.75
49.0	1.00	1.33	1.46	1.08	0.87	0.73	0.63	0.55
50.0	1.00	1.34	1.44	1.06	0.85	0.71	0.62	0.54
75.0	1.00	1.41	1.06	0.78	0.63	0.53	0.46	0.40
97.0	1.00	1.46	0.87	0.65	0.52	0.44	0.38	0.34
100.0	1.00	1.43	0.85	0.63	0.51	0.43	0.38	0.33
Em/Ei cr		97.00	49.00	33.00	25.00	20.20	17.00	14.71

Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.2	1.25	1.27
5.0	1.28	1.30
5.8	1.31	1.32
7.4	1.35	1.36
10.0	1.40	1.41
10.6	1.41	1.42
11.7	1.43	1.44
13.0	1.44	1.32
14.7	1.30	1.19
17.0	1.16	1.05
20.0	1.01	0.92
20.2	1.00	0.91
25.0	0.84	0.76
30.0	0.73	0.66
33.0	0.67	0.61
49.0	0.49	0.44
50.0	0.49	0.44
75.0	0.36	0.33
97.0	0.30	0.27
100.0	0.30	0.27
Em/Ei cr	13.00	11.67

tratout Fri Dec 18 12:48:54 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.06	1.10	1.14	1.17	1.20	1.23	1.25
5.0	1.00	1.07	1.12	1.17	1.20	1.23	1.26	1.28
5.8	1.00	1.08	1.14	1.19	1.23	1.26	1.28	1.31
7.4	1.00	1.10	1.17	1.22	1.27	1.30	1.33	1.35
10.0	1.00	1.13	1.21	1.27	1.32	1.35	1.38	1.40
10.7	1.00	1.14	1.22	1.28	1.33	1.36	1.39	1.41
11.7	1.00	1.15	1.24	1.30	1.34	1.38	1.41	1.43
13.1	1.00	1.16	1.25	1.32	1.36	1.40	1.43	1.45
14.8	1.00	1.18	1.27	1.34	1.38	1.42	1.45	1.47
17.1	1.00	1.20	1.30	1.36	1.41	1.45	1.48	1.31
20.0	1.00	1.22	1.32	1.39	1.44	1.48	1.30	1.15
20.3	1.00	1.22	1.32	1.39	1.44	1.48	1.29	1.14
25.2	1.00	1.25	1.36	1.43	1.48	1.25	1.08	0.96
30.0	1.00	1.28	1.39	1.47	1.29	1.09	0.94	0.83
33.2	1.00	1.29	1.41	1.49	1.20	1.00	0.87	0.76
49.3	1.00	1.36	1.49	1.10	0.88	0.74	0.64	0.56
50.0	1.00	1.36	1.47	1.09	0.87	0.73	0.63	0.55
75.0	1.00	1.43	1.08	0.80	0.64	0.54	0.47	0.41
97.7	1.00	1.49	0.89	0.66	0.53	0.45	0.39	0.34
100.0	1.00	1.46	0.87	0.64	0.52	0.44	0.38	0.34
Em/Ei cr		97.67	49.33	33.22	25.17	20.33	17.11	14.81

Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.2	1.27	1.28
5.0	1.30	1.31
5.8	1.33	1.34
7.4	1.37	1.39
10.0	1.42	1.44
10.7	1.43	1.45
11.7	1.45	1.47
13.1	1.47	1.34
14.8	1.33	1.21
17.1	1.18	1.07
20.0	1.03	0.94
20.3	1.02	0.92
25.2	0.86	0.77
30.0	0.74	0.67
33.2	0.68	0.62
49.3	0.50	0.45
50.0	0.50	0.45
75.0	0.37	0.33
97.7	0.31	0.28
100.0	0.30	0.27
Em/Ei cr	13.08	11.74

tratout   Fri Dec 18 12:48:59 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0   Vf = 0.65   max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.07	1.12	1.17	1.20	1.23	1.26	1.28
5.0	1.00	1.08	1.14	1.19	1.23	1.26	1.29	1.32
5.9	1.00	1.09	1.16	1.22	1.26	1.29	1.32	1.35
7.5	1.00	1.12	1.20	1.26	1.30	1.34	1.37	1.40
10.0	1.00	1.15	1.25	1.31	1.36	1.40	1.43	1.45
10.8	1.00	1.16	1.26	1.32	1.37	1.41	1.44	1.47
11.9	1.00	1.17	1.27	1.34	1.39	1.43	1.46	1.48
13.3	1.00	1.19	1.29	1.36	1.41	1.45	1.48	1.51
15.0	1.00	1.21	1.31	1.38	1.43	1.47	1.51	1.53
17.3	1.00	1.23	1.34	1.41	1.46	1.50	1.54	1.36
20.0	1.00	1.25	1.36	1.44	1.49	1.53	1.37	1.21
20.6	1.00	1.25	1.37	1.44	1.50	1.54	1.33	1.18
25.5	1.00	1.29	1.41	1.49	1.54	1.30	1.12	0.99
30.0	1.00	1.31	1.44	1.52	1.36	1.14	0.98	0.87
33.7	1.00	1.33	1.46	1.55	1.24	1.04	0.90	0.79
50.0	1.00	1.40	1.55	1.14	0.91	0.76	0.66	0.58
50.0	1.00	1.40	1.55	1.14	0.91	0.76	0.66	0.58
75.0	1.00	1.48	1.13	0.83	0.67	0.56	0.49	0.43
99.0	1.00	1.54	0.92	0.68	0.55	0.46	0.40	0.36
100.0	1.00	1.53	0.91	0.67	0.54	0.46	0.40	0.35
Em/Ei cr		99.00	50.00	33.67	25.50	20.60	17.33	15.00

Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.3	1.31	1.32
5.0	1.34	1.36
5.9	1.37	1.39
7.5	1.42	1.44
10.0	1.47	1.49
10.8	1.49	1.50
11.9	1.51	1.52
13.3	1.53	1.39
15.0	1.38	1.25
17.3	1.22	1.11
20.0	1.08	0.98
20.6	1.06	0.96
25.5	0.88	0.80
30.0	0.77	0.70
33.7	0.71	0.64
50.0	0.52	0.47
50.0	0.52	0.47
75.0	0.38	0.35
99.0	0.32	0.29
100.0	0.32	0.29
Em/Ei cr	13.25	11.89

tratout Fri Dec 18 12:49:04 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

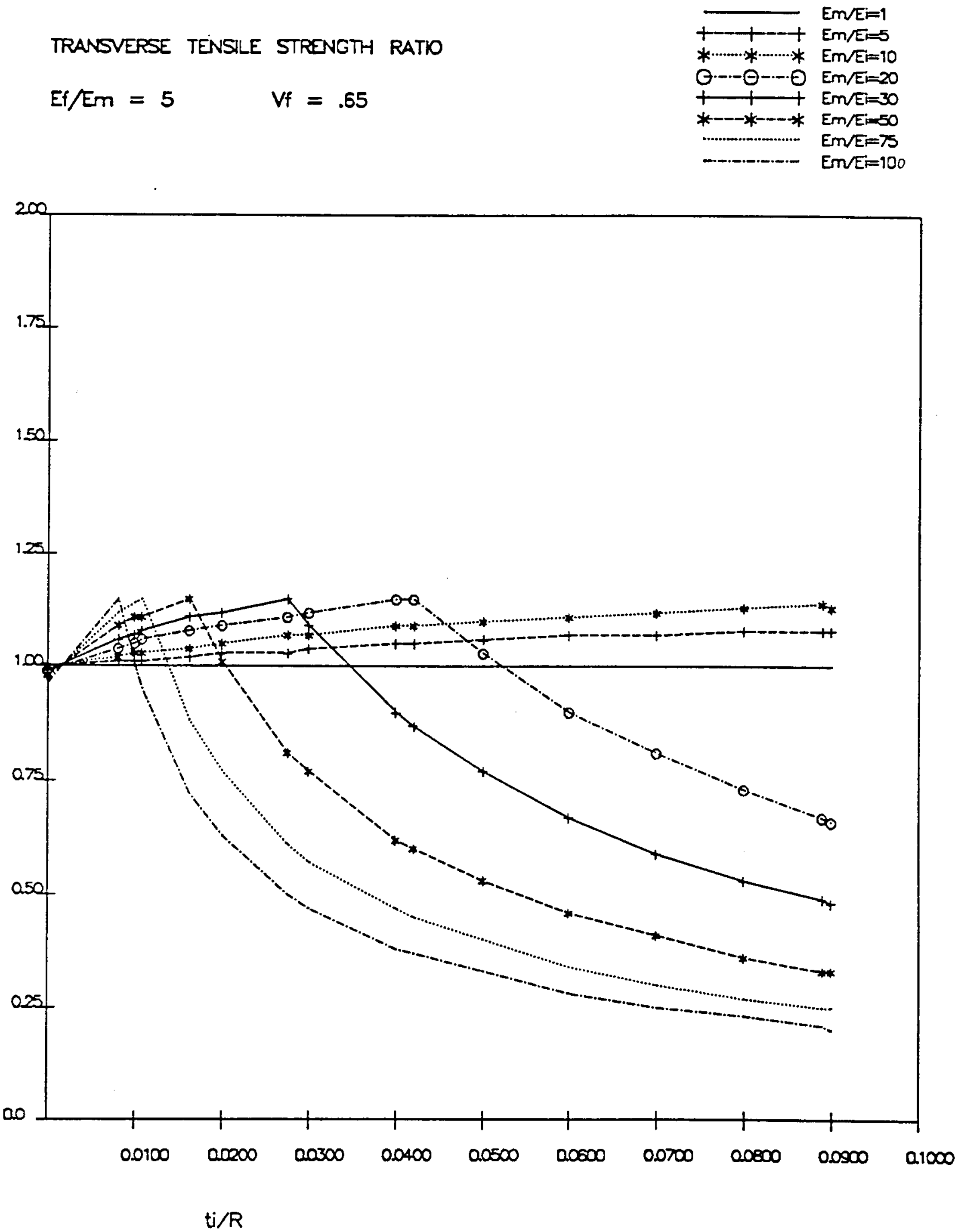
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em =100.0 Vf = 0.65 max ti/R = 0.099

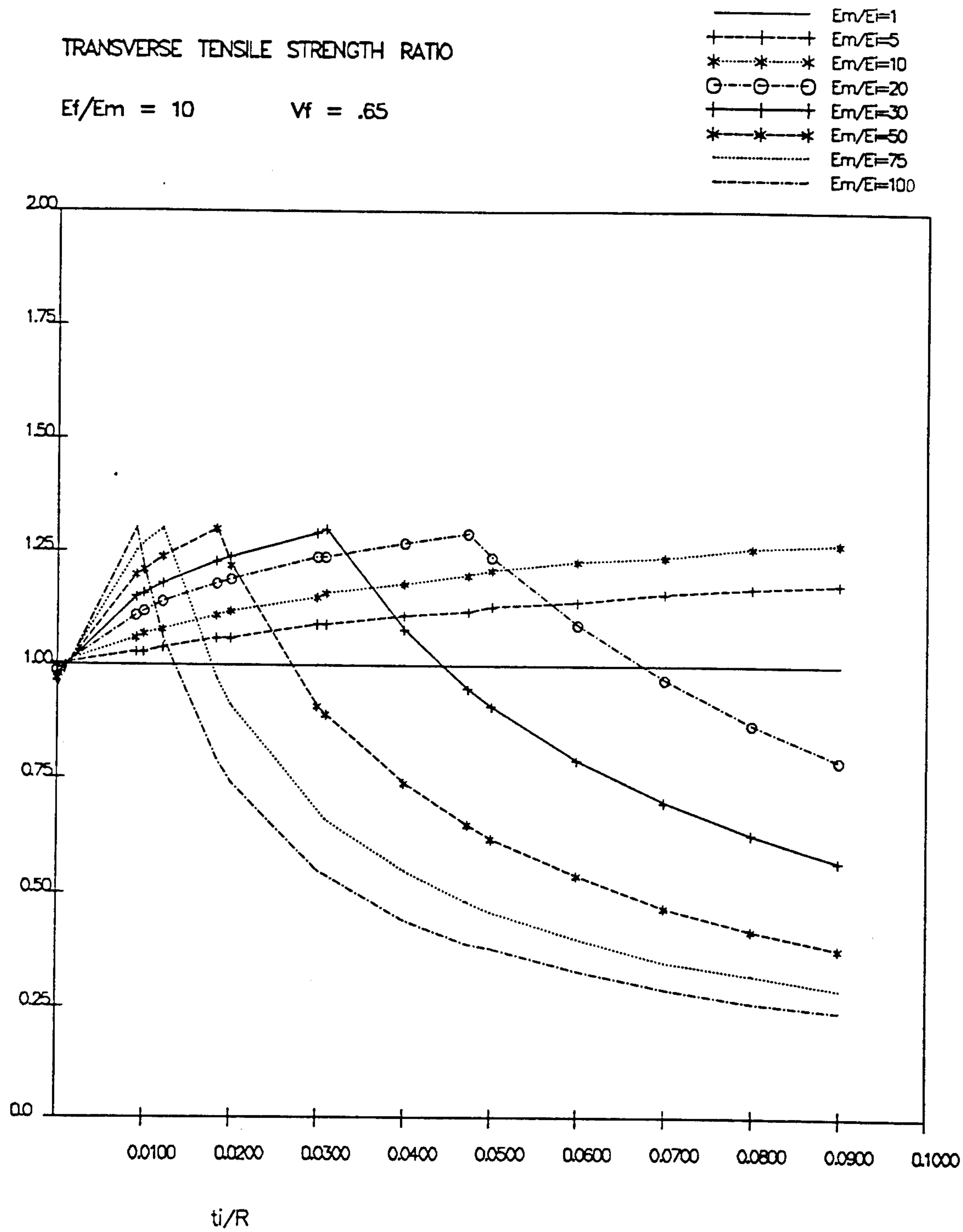
TRANSVERSE TENSILE STRENGTH RATIO

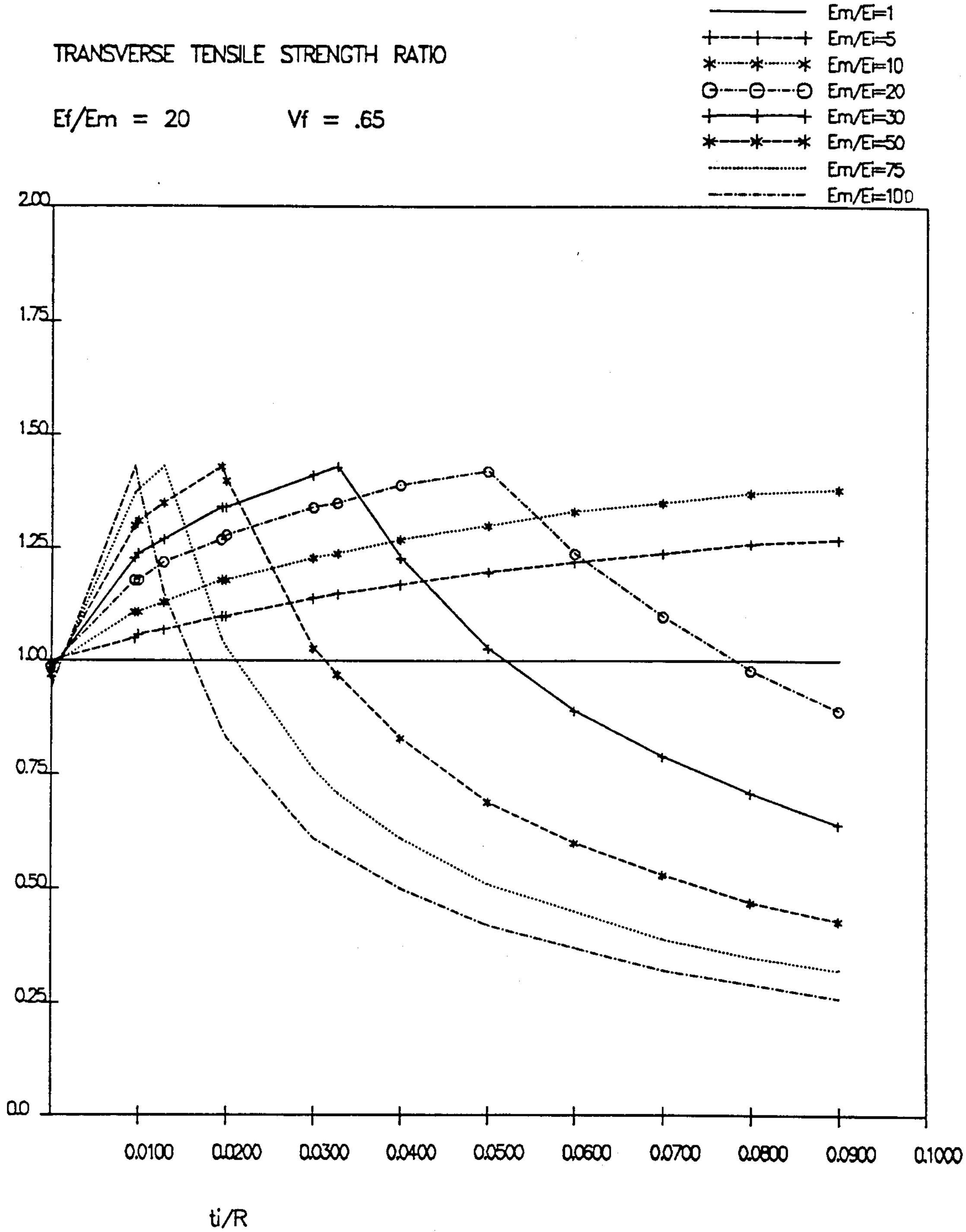
Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.08	1.14	1.19	1.23	1.26	1.29	1.32
5.0	1.00	1.09	1.16	1.21	1.26	1.29	1.32	1.35
5.9	1.00	1.11	1.19	1.25	1.29	1.33	1.36	1.39
7.6	1.00	1.14	1.23	1.29	1.34	1.38	1.41	1.44
10.0	1.00	1.17	1.27	1.34	1.39	1.44	1.47	1.50
10.9	1.00	1.18	1.29	1.36	1.41	1.45	1.49	1.51
12.0	1.00	1.20	1.31	1.38	1.43	1.47	1.51	1.53
13.4	1.00	1.21	1.33	1.40	1.45	1.49	1.53	1.56
15.1	1.00	1.23	1.35	1.42	1.48	1.52	1.55	1.58
17.5	1.00	1.26	1.38	1.45	1.51	1.55	1.59	1.40
20.0	1.00	1.28	1.40	1.48	1.54	1.58	1.42	1.26
20.8	1.00	1.28	1.41	1.49	1.55	1.59	1.38	1.22
25.8	1.00	1.32	1.45	1.53	1.59	1.34	1.16	1.02
30.0	1.00	1.35	1.48	1.57	1.41	1.18	1.02	0.90
34.0	1.00	1.37	1.51	1.60	1.28	1.07	0.92	0.81
50.0	1.00	1.44	1.60	1.18	0.94	0.79	0.68	0.60
50.5	1.00	1.45	1.60	1.17	0.94	0.78	0.68	0.60
75.0	1.00	1.53	1.18	0.86	0.69	0.58	0.50	0.45
100.0	1.00	1.59	0.95	0.70	0.56	0.48	0.41	0.37
100.0	1.00	1.59	0.95	0.70	0.56	0.48	0.41	0.37
Em/Ei cr		100.00	50.50	34.00	25.75	20.80	17.50	15.14

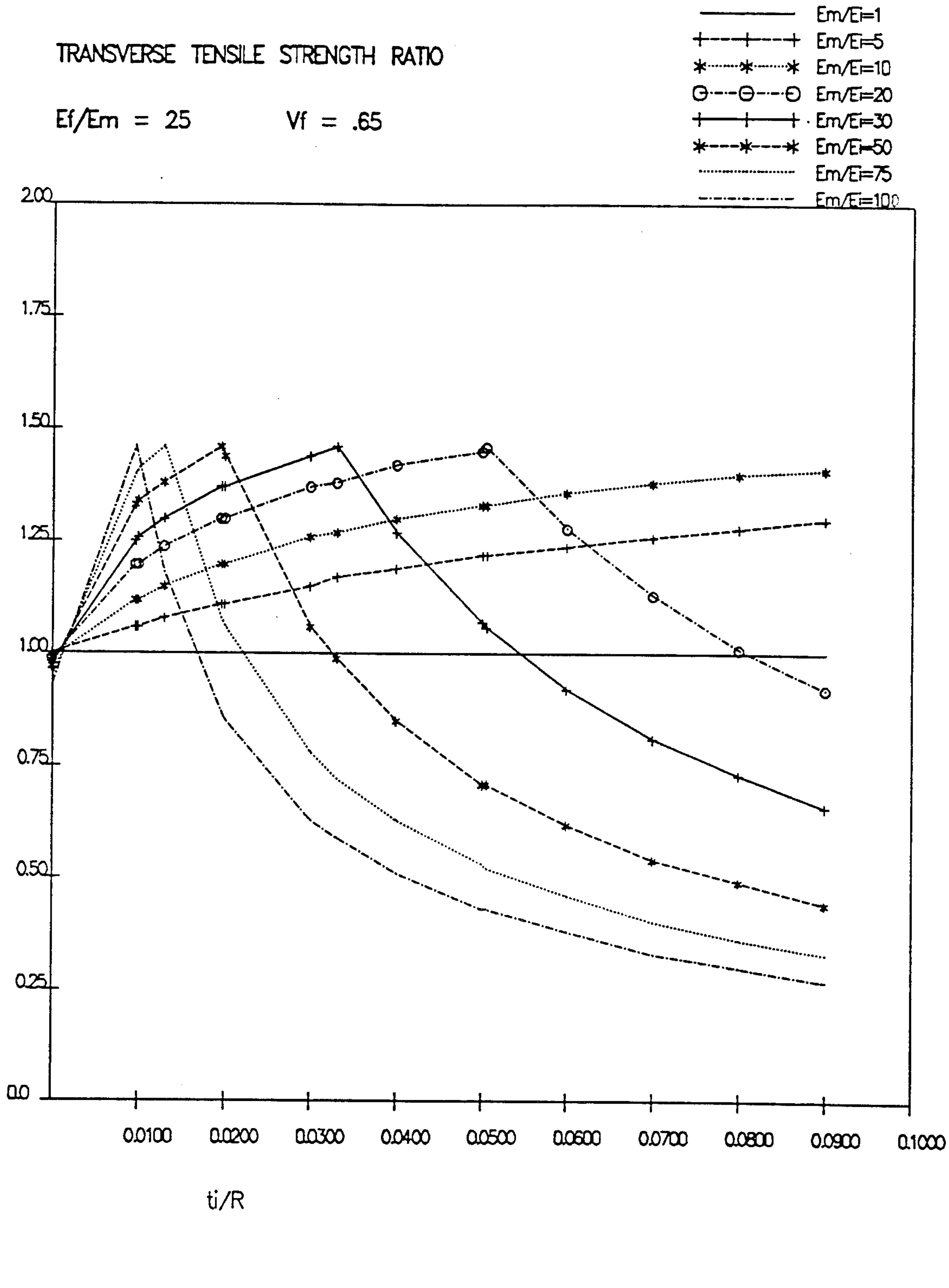
Em/Ei	ti / R 0.08	0.09
1.0	1.00	1.00
4.3	1.34	1.36
5.0	1.37	1.39
5.9	1.41	1.43
7.6	1.46	1.48
10.0	1.52	1.54
10.9	1.54	1.55
12.0	1.56	1.57
13.4	1.58	1.43
15.1	1.42	1.29
17.5	1.26	1.14
20.0	1.12	1.02
20.8	1.09	0.98
25.8	0.91	0.82
30.0	0.80	0.73
34.0	0.73	0.65
50.0	0.54	0.48
50.5	0.53	0.48
75.0	0.40	0.36
100.0	0.33	0.30
100.0	0.33	0.30
Em/Ei cr	13.38	12.00



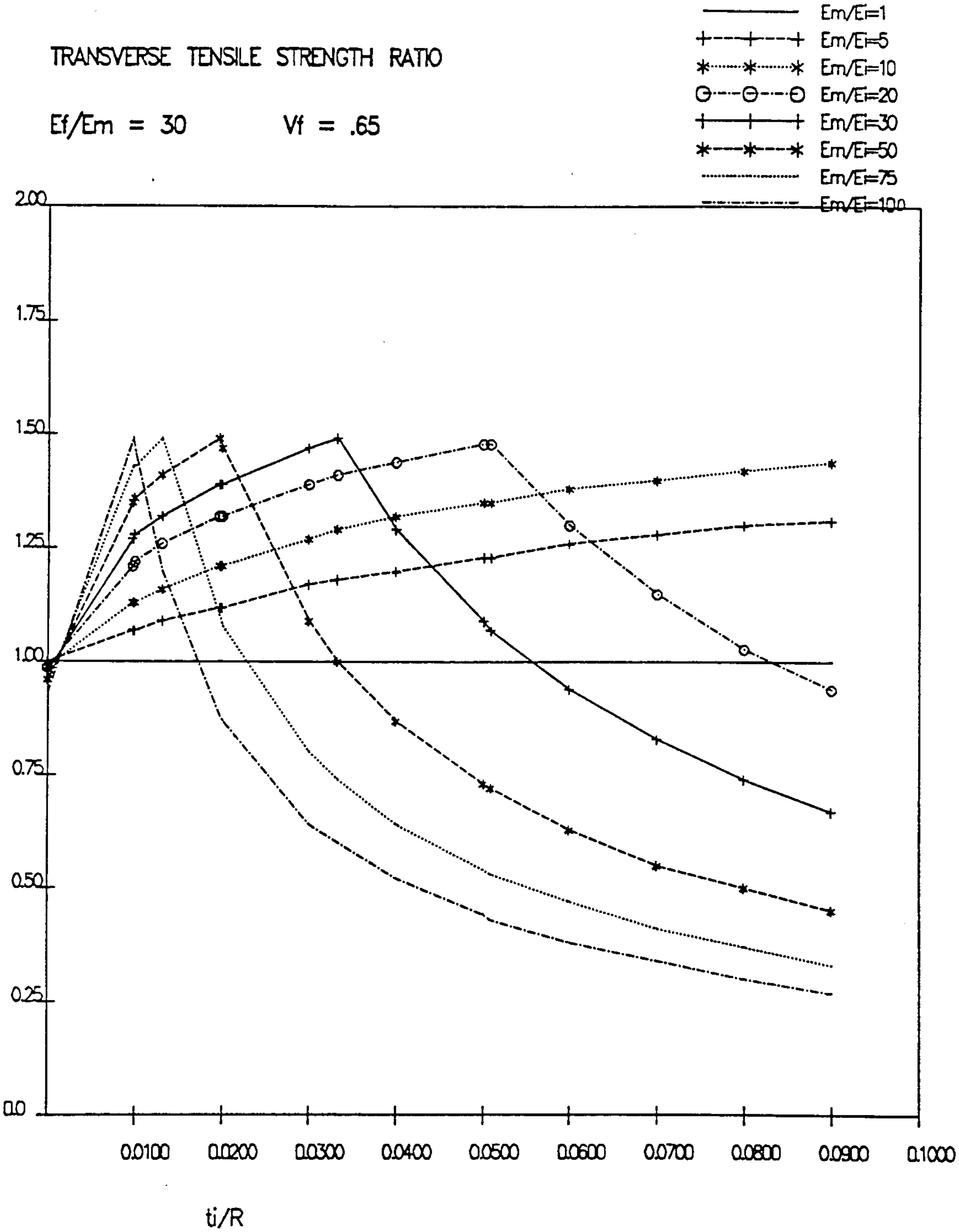
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5 Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R

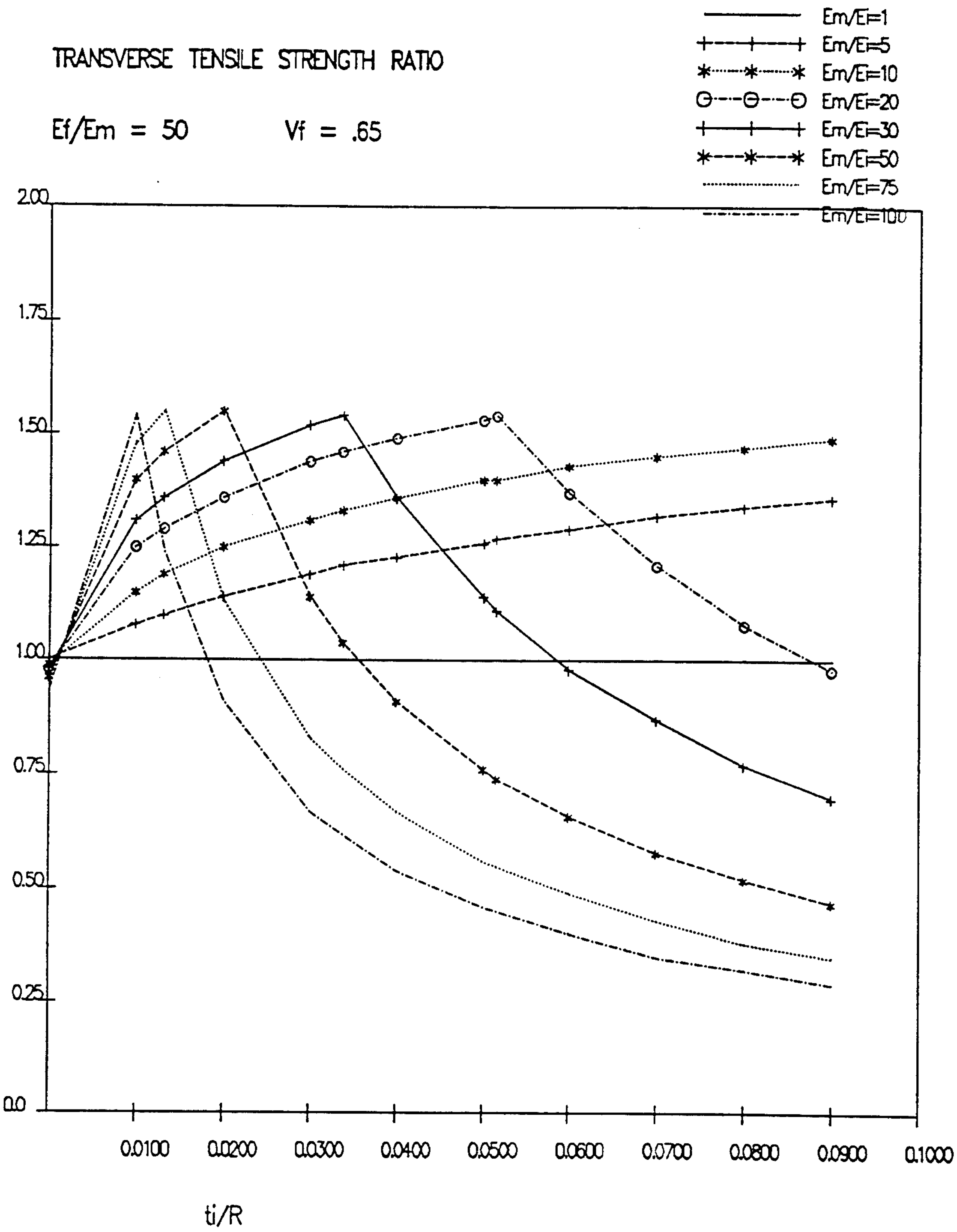

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R

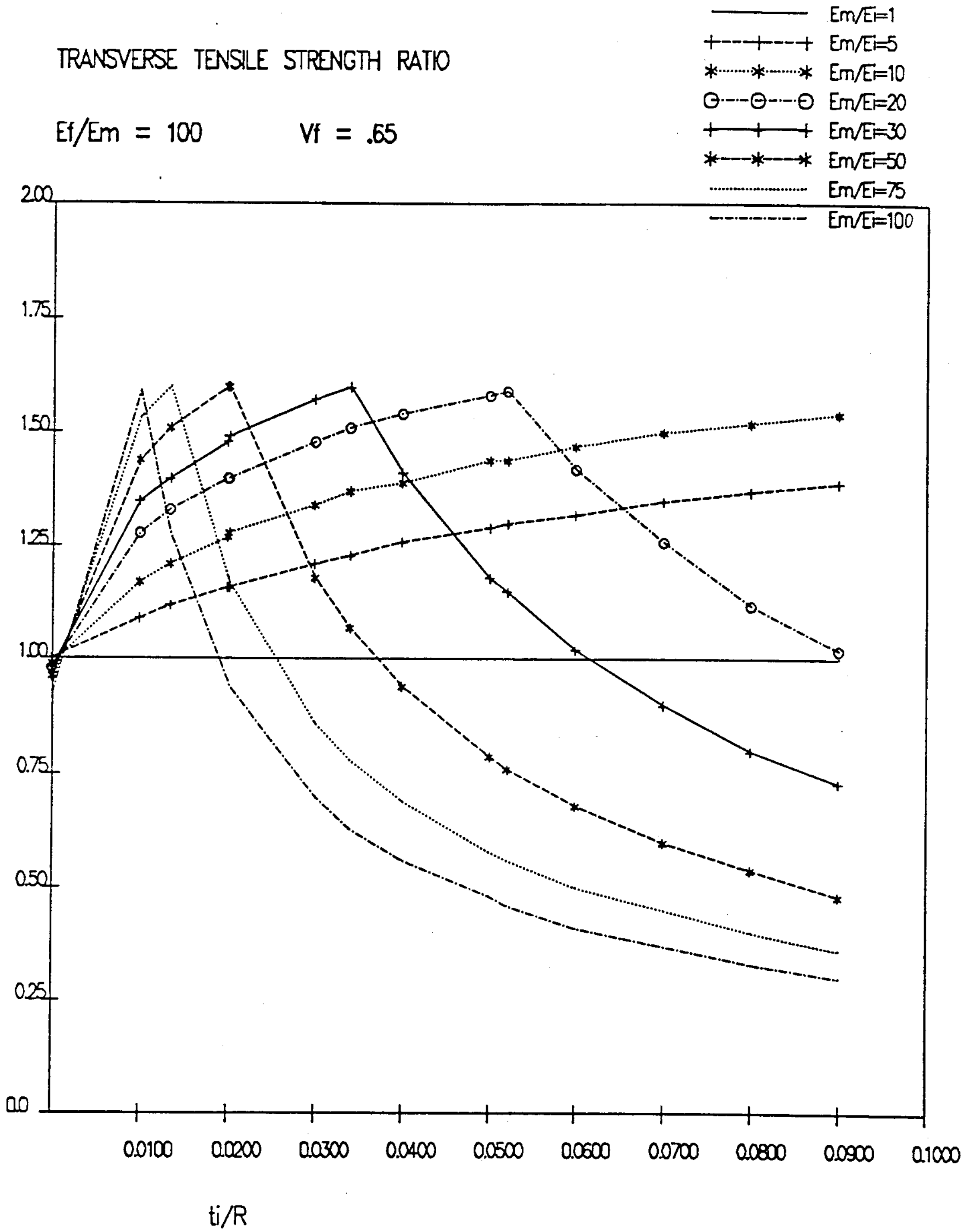

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .65
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
0.0700
0.0800
0.0900
0.1000
ti/R

tratout Fri Dec 18 15:33:24 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.008	1.00	1.01	1.02	1.04	1.06	1.09	1.12	1.15
0.010	1.00	1.01	1.03	1.05	1.07	1.11	1.14	1.00
0.011	1.00	1.01	1.03	1.06	1.08	1.11	1.15	0.95
0.016	1.00	1.02	1.04	1.08	1.11	1.15	0.88	0.72
0.020	1.00	1.03	1.05	1.09	1.12	1.01	0.77	0.63
0.028	1.00	1.03	1.07	1.11	1.15	0.81	0.61	0.50
0.030	1.00	1.04	1.07	1.12	1.09	0.77	0.57	0.47
0.040	1.00	1.05	1.09	1.15	0.90	0.62	0.47	0.38
0.042	1.00	1.05	1.09	1.15	0.87	0.60	0.45	0.37
0.050	1.00	1.06	1.10	1.03	0.77	0.53	0.40	0.33
0.060	1.00	1.07	1.11	0.90	0.67	0.46	0.34	0.28
0.070	1.00	1.07	1.12	0.81	0.59	0.41	0.30	0.25
0.080	1.00	1.08	1.13	0.73	0.53	0.36	0.27	0.23
0.089	1.00	1.08	1.14	0.67	0.49	0.33	0.25	0.21
0.090	1.00	1.08	1.13	0.66	0.48	0.33	0.25	0.20
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout **Fri Dec 18 15:33:28 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.98	0.97	0.96	0.95
0.009	1.00	1.03	1.06	1.11	1.15	1.20	1.25	1.30
0.010	1.00	1.03	1.07	1.12	1.16	1.21	1.27	1.21
0.012	1.00	1.04	1.08	1.14	1.18	1.24	1.30	1.06
0.018	1.00	1.06	1.11	1.18	1.23	1.30	0.97	0.79
0.020	1.00	1.06	1.12	1.19	1.24	1.22	0.91	0.74
0.030	1.00	1.09	1.15	1.24	1.29	0.91	0.68	0.55
0.031	1.00	1.09	1.16	1.24	1.30	0.89	0.66	0.54
0.040	1.00	1.11	1.18	1.27	1.08	0.74	0.55	0.44
0.047	1.00	1.12	1.20	1.29	0.95	0.65	0.48	0.39
0.050	1.00	1.13	1.21	1.24	0.91	0.62	0.46	0.38
0.060	1.00	1.14	1.23	1.09	0.79	0.54	0.40	0.33
0.070	1.00	1.16	1.24	0.97	0.70	0.47	0.35	0.29
0.080	1.00	1.17	1.26	0.87	0.63	0.42	0.32	0.26
0.090	1.00	1.18	1.27	0.79	0.57	0.38	0.29	0.24
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout Fri Dec 18 15:33:33 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.95	0.94
0.010	1.00	1.05	1.11	1.18	1.23	1.30	1.37	1.43
0.010	1.00	1.06	1.11	1.18	1.24	1.31	1.38	1.38
0.013	1.00	1.07	1.13	1.22	1.27	1.35	1.43	1.15
0.019	1.00	1.10	1.18	1.27	1.34	1.43	1.05	0.85
0.020	1.00	1.10	1.18	1.28	1.34	1.40	1.03	0.83
0.030	1.00	1.14	1.23	1.34	1.41	1.03	0.76	0.61
0.033	1.00	1.15	1.24	1.35	1.43	0.97	0.71	0.58
0.040	1.00	1.17	1.27	1.39	1.23	0.83	0.61	0.50
0.050	1.00	1.20	1.30	1.42	1.03	0.69	0.51	0.42
0.050	1.00	1.20	1.30	1.42	1.03	0.69	0.51	0.42
0.060	1.00	1.22	1.33	1.24	0.89	0.60	0.45	0.37
0.070	1.00	1.24	1.35	1.10	0.79	0.53	0.39	0.32
0.080	1.00	1.26	1.37	0.98	0.71	0.47	0.35	0.29
0.090	1.00	1.27	1.38	0.89	0.64	0.43	0.32	0.26
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout Fri Dec 18 15:33:39 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.95	0.93
0.010	1.00	1.06	1.12	1.20	1.25	1.33	1.40	1.46
0.010	1.00	1.06	1.12	1.20	1.26	1.34	1.41	1.43
0.013	1.00	1.08	1.15	1.24	1.30	1.38	1.46	1.18
0.020	1.00	1.11	1.20	1.30	1.37	1.46	1.08	0.87
0.020	1.00	1.11	1.20	1.30	1.37	1.44	1.06	0.85
0.030	1.00	1.15	1.26	1.37	1.44	1.06	0.78	0.63
0.033	1.00	1.17	1.27	1.38	1.46	0.99	0.72	0.59
0.040	1.00	1.19	1.30	1.42	1.27	0.85	0.63	0.51
0.050	1.00	1.22	1.33	1.45	1.07	0.71	0.53	0.43
0.051	1.00	1.22	1.33	1.46	1.06	0.71	0.52	0.43
0.060	1.00	1.24	1.36	1.28	0.92	0.62	0.46	0.38
0.070	1.00	1.26	1.38	1.13	0.81	0.54	0.40	0.33
0.080	1.00	1.28	1.40	1.01	0.73	0.49	0.36	0.30
0.090	1.00	1.30	1.41	0.92	0.66	0.44	0.33	0.27
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout **Fri Dec 18 15:33:44 1992** **1**

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.65 max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.96	0.95	0.93
0.010	1.00	1.07	1.13	1.21	1.27	1.35	1.43	1.49
0.010	1.00	1.07	1.13	1.22	1.28	1.36	1.43	1.46
0.013	1.00	1.09	1.16	1.26	1.32	1.41	1.49	1.20
0.020	1.00	1.12	1.21	1.32	1.39	1.49	1.10	0.88
0.020	1.00	1.12	1.21	1.32	1.39	1.47	1.08	0.87
0.030	1.00	1.17	1.27	1.39	1.47	1.09	0.80	0.64
0.033	1.00	1.18	1.29	1.41	1.49	1.00	0.74	0.60
0.040	1.00	1.20	1.32	1.44	1.29	0.87	0.64	0.52
0.050	1.00	1.23	1.35	1.48	1.09	0.73	0.54	0.44
0.051	1.00	1.23	1.35	1.48	1.07	0.72	0.53	0.43
0.060	1.00	1.26	1.38	1.30	0.94	0.63	0.47	0.38
0.070	1.00	1.28	1.40	1.15	0.83	0.55	0.41	0.34
0.080	1.00	1.30	1.42	1.03	0.74	0.50	0.37	0.30
0.090	1.00	1.31	1.44	0.94	0.67	0.45	0.33	0.27
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout   Fri Dec 18 15:33:48 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0   Vf = 0.65   max ti/R = 0.099

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.98	0.96	0.94	0.93
0.010	1.00	1.08	1.15	1.25	1.31	1.40	1.48	1.54
0.010	1.00	1.08	1.15	1.25	1.31	1.40	1.48	1.53
0.013	1.00	1.10	1.19	1.29	1.36	1.46	1.55	1.24
0.020	1.00	1.14	1.25	1.36	1.44	1.55	1.13	0.91
0.020	1.00	1.14	1.25	1.36	1.44	1.55	1.13	0.91
0.030	1.00	1.19	1.31	1.44	1.52	1.14	0.83	0.67
0.034	1.00	1.21	1.33	1.46	1.54	1.04	0.76	0.62
0.040	1.00	1.23	1.36	1.49	1.36	0.91	0.67	0.54
0.050	1.00	1.26	1.40	1.53	1.14	0.76	0.56	0.46
0.052	1.00	1.27	1.40	1.54	1.11	0.74	0.55	0.45
0.060	1.00	1.29	1.43	1.37	0.98	0.66	0.49	0.40
0.070	1.00	1.32	1.45	1.21	0.87	0.58	0.43	0.35
0.080	1.00	1.34	1.47	1.08	0.77	0.52	0.38	0.32
0.090	1.00	1.36	1.49	0.98	0.70	0.47	0.35	0.29
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Fri Dec 18 15:33:52 1992 1

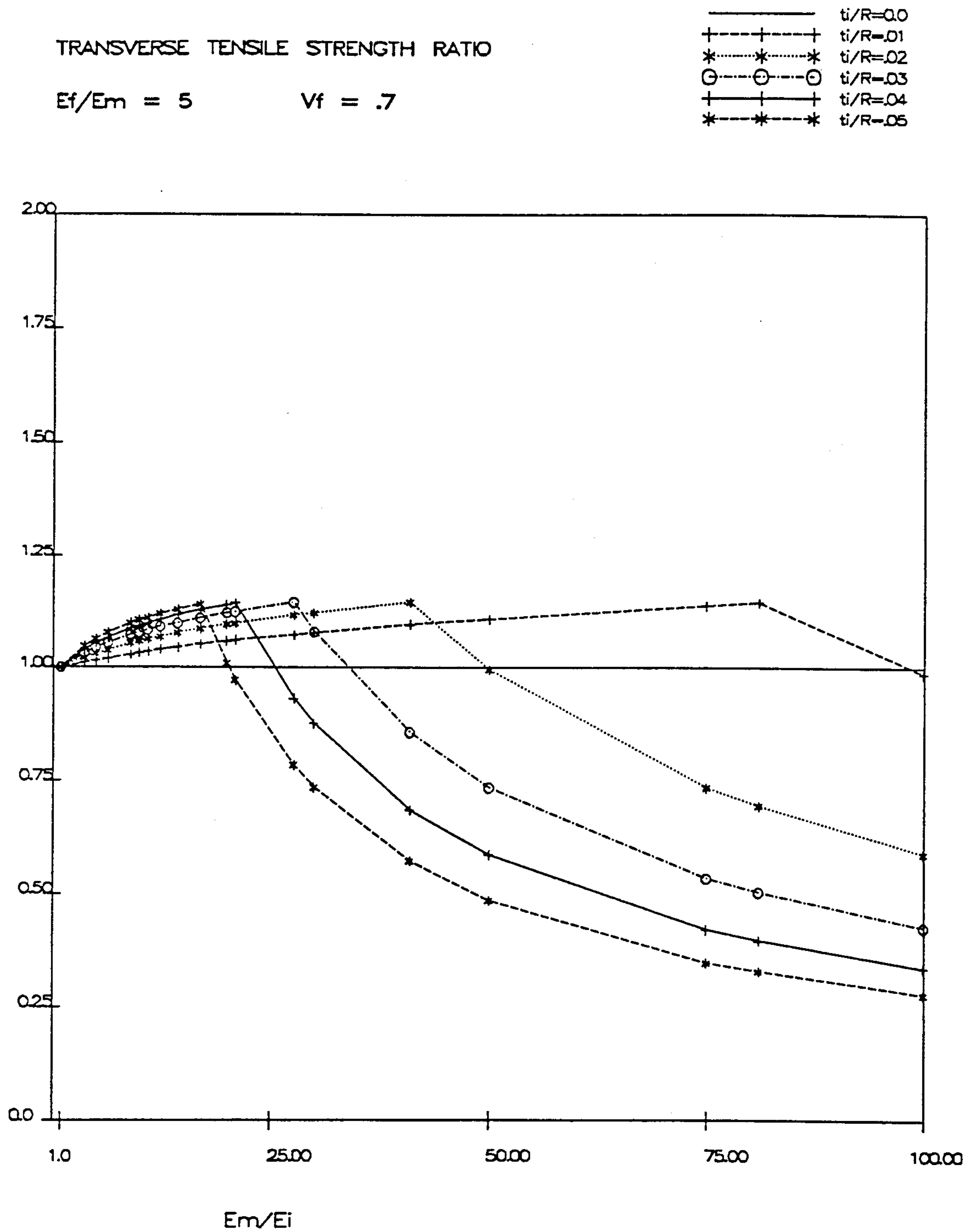
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

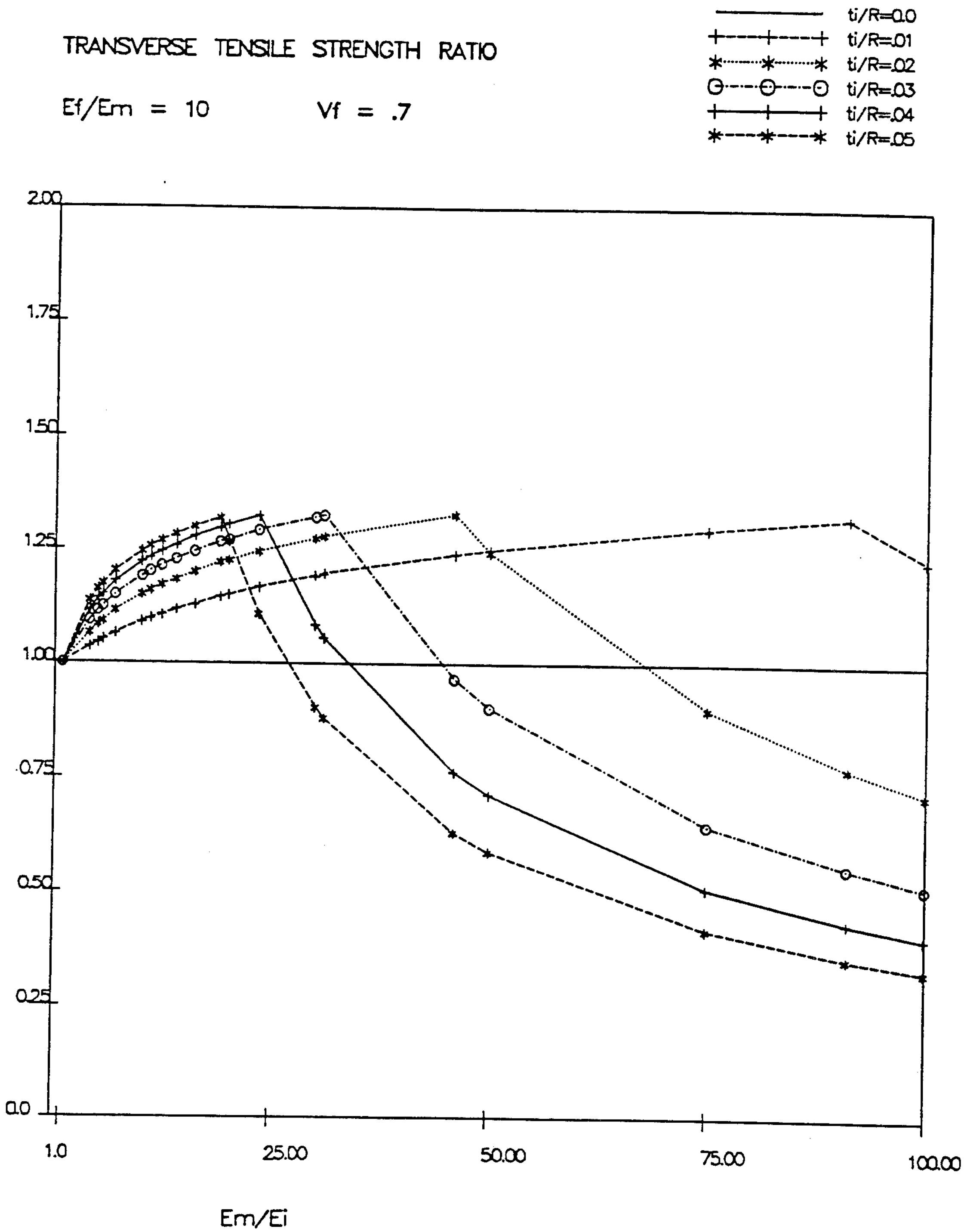
Ef / Em =100.0 Vf = 0.65 max ti/R = 0.099

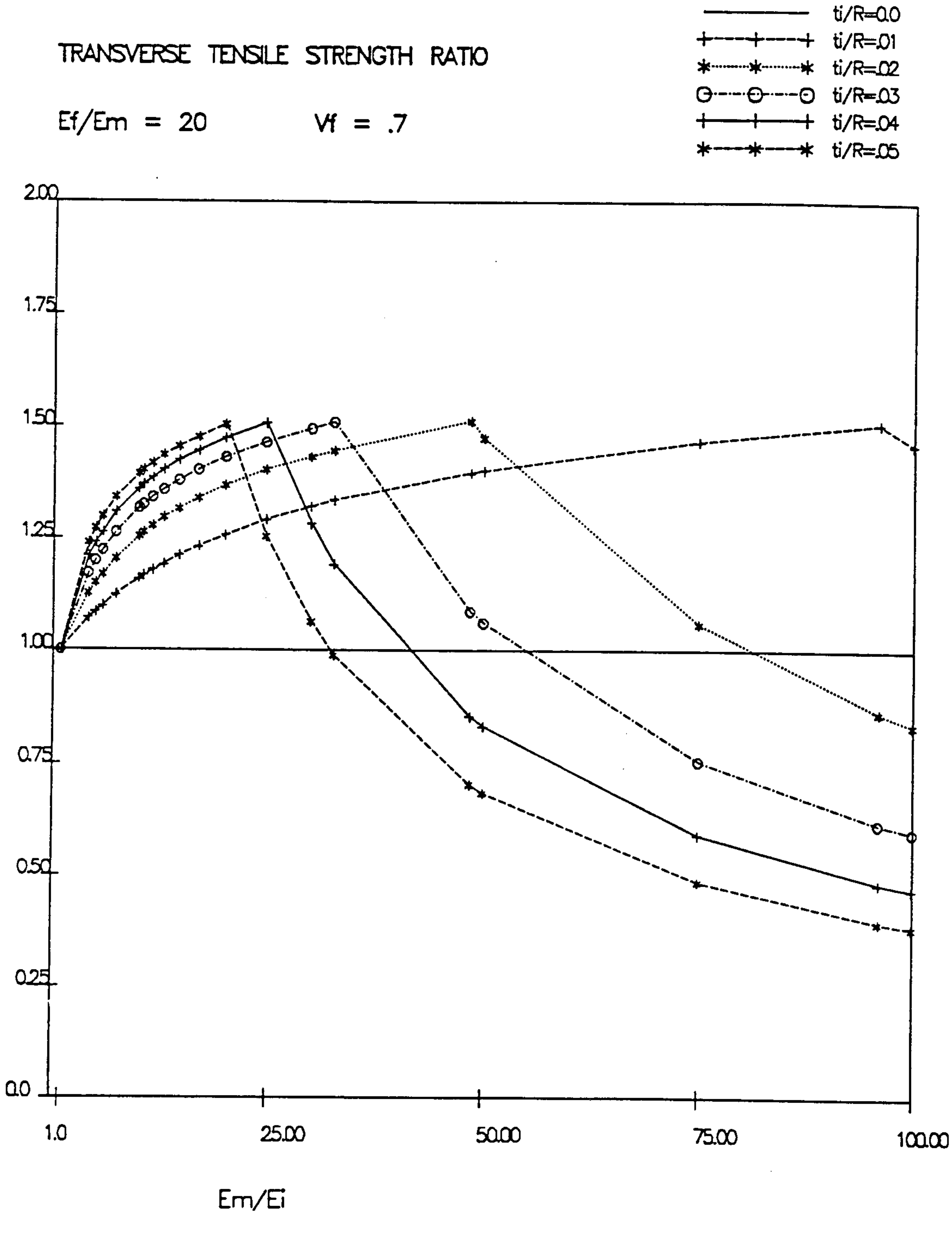
TRANSVERSE TENSILE STRENGTH RATIO

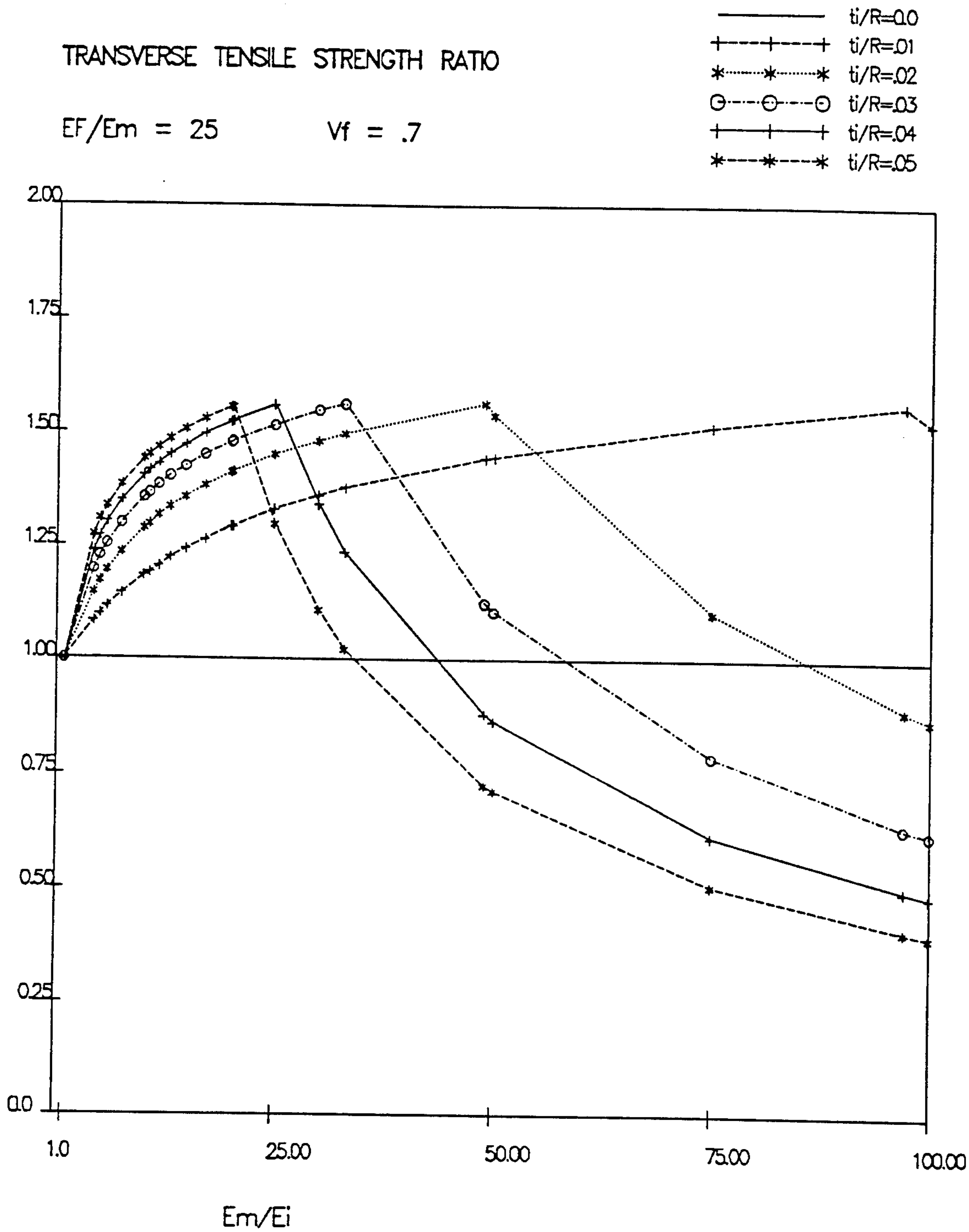
	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.98	0.96	0.94	0.92
0.010	1.00	1.09	1.17	1.28	1.35	1.44	1.53	1.59
0.010	1.00	1.09	1.17	1.28	1.35	1.44	1.53	1.59
0.013	1.00	1.12	1.21	1.33	1.40	1.51	1.60	1.28
0.020	1.00	1.16	1.27	1.40	1.48	1.60	1.18	0.95
0.020	1.00	1.16	1.28	1.40	1.49	1.60	1.17	0.94
0.030	1.00	1.21	1.34	1.48	1.57	1.18	0.86	0.70
0.034	1.00	1.23	1.37	1.51	1.60	1.07	0.78	0.63
0.040	1.00	1.26	1.39	1.54	1.41	0.94	0.69	0.56
0.050	1.00	1.29	1.44	1.58	1.18	0.79	0.58	0.48
0.052	1.00	1.30	1.44	1.59	1.15	0.76	0.56	0.46
0.060	1.00	1.32	1.47	1.42	1.02	0.68	0.50	0.41
0.070	1.00	1.35	1.50	1.26	0.90	0.60	0.45	0.37
0.080	1.00	1.37	1.52	1.12	0.80	0.54	0.40	0.33
0.090	1.00	1.39	1.54	1.02	0.73	0.48	0.36	0.30
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010

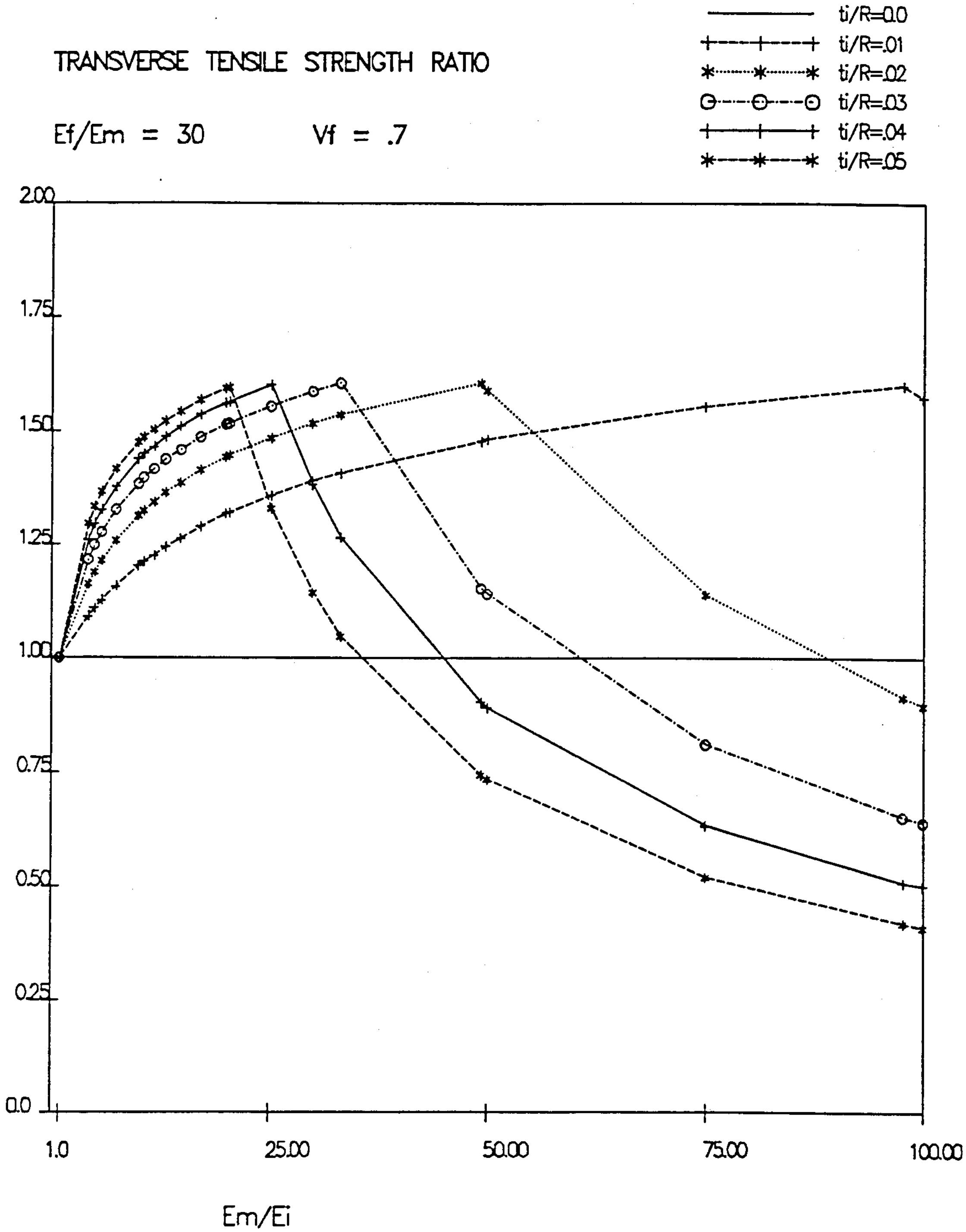


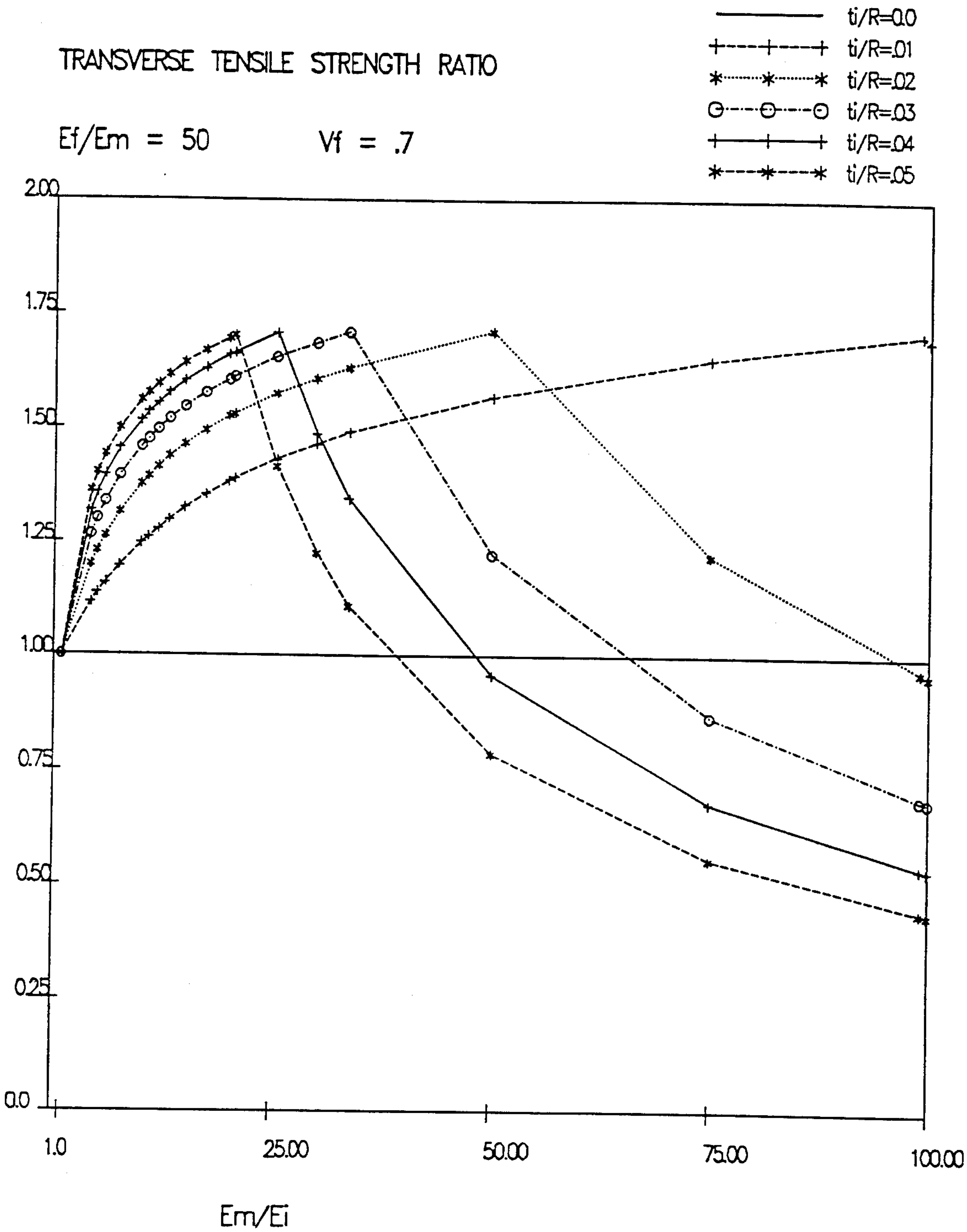
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5 Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

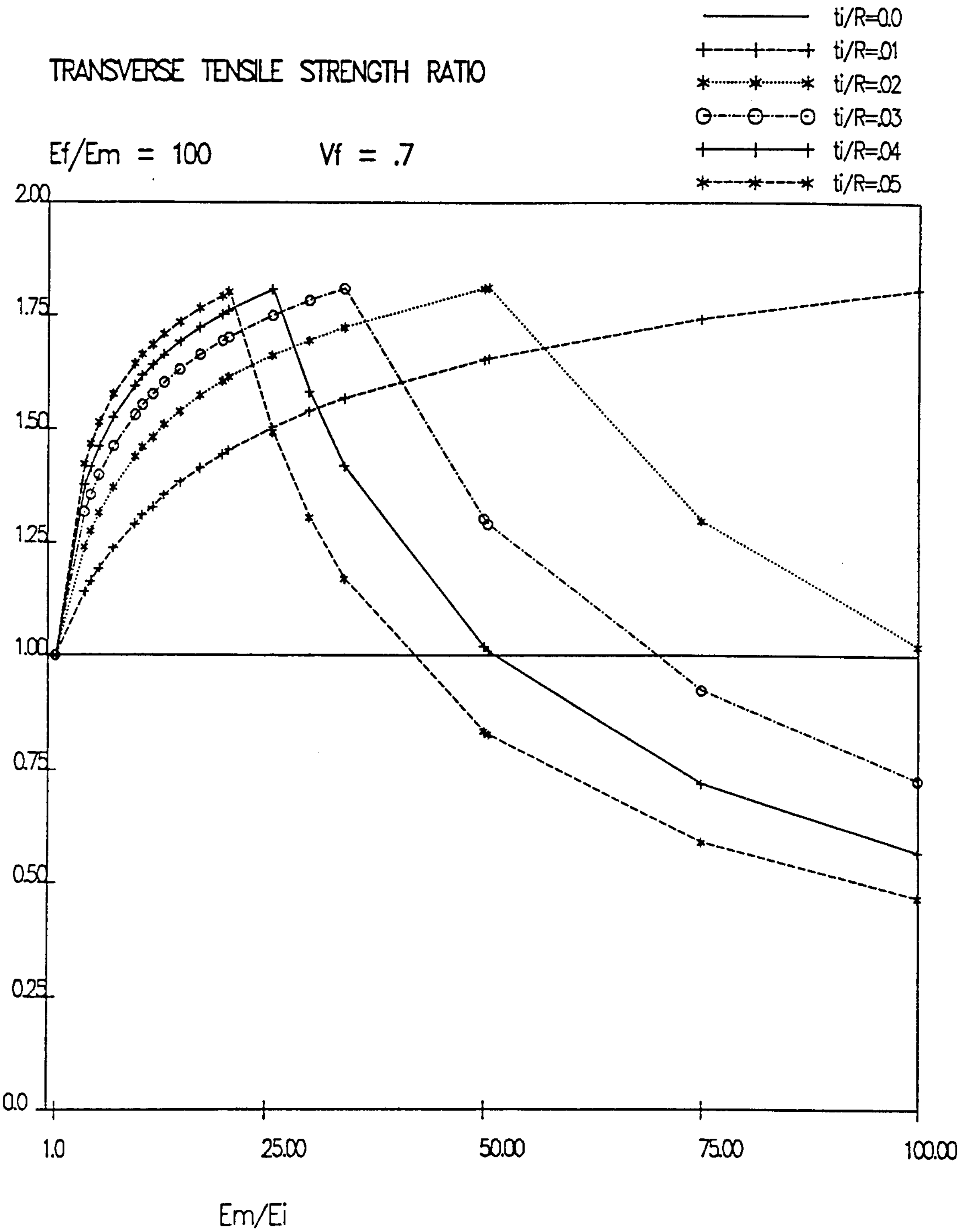

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .7
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
EF/Em = 25
Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100
Vf = .7
ti/R=0.0
ti/R=.01
ti/R=.02
ti/R=.03
ti/R=.04
ti/R=.05
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
1.0
25.00
50.00
75.00
100.00
Em/Ei

tratout Fri Dec 18 13:08:09 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	ti / R					
Em/Ei	0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
3.7	1.00	1.01	1.02	1.03	1.04	1.05
5.0	1.00	1.02	1.03	1.04	1.06	1.07
5.0	1.00	1.02	1.03	1.04	1.06	1.07
6.3	1.00	1.02	1.04	1.06	1.07	1.08
9.0	1.00	1.03	1.05	1.07	1.09	1.10
9.9	1.00	1.03	1.06	1.08	1.09	1.11
10.0	1.00	1.03	1.06	1.08	1.09	1.11
11.0	1.00	1.04	1.06	1.08	1.10	1.11
12.4	1.00	1.04	1.07	1.09	1.11	1.12
14.3	1.00	1.05	1.08	1.10	1.12	1.13
17.0	1.00	1.05	1.09	1.11	1.13	1.14
20.0	1.00	1.06	1.10	1.12	1.14	1.01
21.0	1.00	1.06	1.10	1.13	1.14	0.97
27.7	1.00	1.08	1.12	1.15	0.93	0.79
30.0	1.00	1.08	1.12	1.08	0.88	0.74
41.0	1.00	1.10	1.15	0.86	0.69	0.57
50.0	1.00	1.11	1.00	0.74	0.59	0.49
75.0	1.00	1.14	0.74	0.54	0.42	0.35
81.0	1.00	1.15	0.69	0.50	0.40	0.33
100.0	1.00	0.99	0.59	0.43	0.34	0.28
Em/Ei cr		81.00	41.00	27.67	21.00	17.00

tratout   Fri Dec 18 13:08:18 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0   Vf = 0.70   max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.0	1.00	1.04	1.07	1.09	1.12	1.14
5.0	1.00	1.05	1.09	1.12	1.14	1.16
5.5	1.00	1.05	1.09	1.13	1.15	1.18
7.0	1.00	1.07	1.12	1.15	1.18	1.20
10.0	1.00	1.09	1.15	1.19	1.22	1.25
10.0	1.00	1.09	1.15	1.19	1.22	1.25
11.0	1.00	1.10	1.16	1.20	1.23	1.26
12.2	1.00	1.11	1.17	1.22	1.25	1.27
13.9	1.00	1.12	1.19	1.23	1.26	1.28
16.0	1.00	1.13	1.20	1.25	1.28	1.30
19.0	1.00	1.15	1.22	1.27	1.30	1.32
20.0	1.00	1.15	1.23	1.27	1.30	1.27
23.5	1.00	1.17	1.25	1.29	1.32	1.11
30.0	1.00	1.19	1.27	1.32	1.09	0.91
31.0	1.00	1.20	1.28	1.33	1.06	0.88
46.0	1.00	1.24	1.33	0.97	0.76	0.63
50.0	1.00	1.25	1.24	0.90	0.71	0.59
75.0	1.00	1.30	0.90	0.65	0.51	0.42
91.0	1.00	1.32	0.77	0.55	0.44	0.36
100.0	1.00	1.23	0.72	0.51	0.40	0.33
Em/Ei cr		91.00	46.00	31.00	23.50	19.00

tratout Fri Dec 18 13:08:24 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.07	1.13	1.17	1.21	1.24
5.0	1.00	1.09	1.15	1.20	1.24	1.27
5.8	1.00	1.10	1.17	1.22	1.27	1.30
7.3	1.00	1.13	1.21	1.27	1.31	1.34
10.0	1.00	1.16	1.26	1.32	1.36	1.40
10.5	1.00	1.17	1.26	1.33	1.37	1.40
11.6	1.00	1.18	1.28	1.34	1.39	1.42
12.9	1.00	1.20	1.30	1.36	1.40	1.44
14.6	1.00	1.21	1.32	1.38	1.42	1.46
16.8	1.00	1.23	1.34	1.40	1.45	1.48
20.0	1.00	1.26	1.37	1.43	1.47	1.50
20.0	1.00	1.26	1.37	1.43	1.47	1.50
24.8	1.00	1.29	1.40	1.47	1.51	1.25
30.0	1.00	1.32	1.43	1.50	1.28	1.06
32.7	1.00	1.33	1.45	1.51	1.19	0.99
48.5	1.00	1.40	1.51	1.09	0.85	0.70
50.0	1.00	1.40	1.48	1.06	0.83	0.69
75.0	1.00	1.47	1.06	0.76	0.59	0.49
96.0	1.00	1.51	0.87	0.62	0.48	0.40
100.0	1.00	1.46	0.84	0.60	0.47	0.38
Em/Ei cr		96.00	48.50	32.67	24.75	20.00

tratout Fri Dec 18 13:08:29 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0   Vf = 0.70   max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.08	1.15	1.20	1.24	1.27
5.0	1.00	1.10	1.17	1.23	1.27	1.31
5.8	1.00	1.12	1.20	1.26	1.30	1.34
7.4	1.00	1.14	1.24	1.30	1.35	1.39
10.0	1.00	1.18	1.29	1.36	1.40	1.44
10.6	1.00	1.19	1.30	1.37	1.42	1.45
11.7	1.00	1.21	1.32	1.38	1.43	1.47
13.0	1.00	1.22	1.34	1.40	1.45	1.49
14.7	1.00	1.24	1.36	1.43	1.47	1.51
17.0	1.00	1.27	1.38	1.45	1.50	1.53
20.0	1.00	1.29	1.41	1.48	1.52	1.56
20.2	1.00	1.29	1.41	1.48	1.53	1.56
25.0	1.00	1.33	1.45	1.52	1.56	1.30
30.0	1.00	1.36	1.48	1.55	1.34	1.11
33.0	1.00	1.38	1.50	1.57	1.24	1.02
49.0	1.00	1.44	1.57	1.13	0.88	0.73
50.0	1.00	1.45	1.54	1.11	0.87	0.71
75.0	1.00	1.52	1.11	0.79	0.62	0.51
97.0	1.00	1.56	0.89	0.64	0.50	0.41
100.0	1.00	1.53	0.87	0.62	0.49	0.40
Em/Ei cr		97.00	49.00	33.00	25.00	20.20

tratout   Fri Dec 18 13:08:33 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 30.0   Vf = 0.70   max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	ti / R					
Em/Ei	0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.2	1.00	1.09	1.16	1.22	1.26	1.30
5.0	1.00	1.11	1.19	1.25	1.30	1.34
5.8	1.00	1.13	1.22	1.28	1.33	1.37
7.4	1.00	1.16	1.26	1.33	1.38	1.42
10.0	1.00	1.20	1.31	1.39	1.44	1.48
10.7	1.00	1.21	1.33	1.40	1.45	1.49
11.7	1.00	1.23	1.34	1.42	1.47	1.51
13.1	1.00	1.25	1.37	1.44	1.49	1.52
14.8	1.00	1.27	1.39	1.46	1.51	1.55
17.1	1.00	1.29	1.42	1.49	1.54	1.57
20.0	1.00	1.32	1.44	1.52	1.56	1.60
20.3	1.00	1.32	1.45	1.52	1.57	1.60
25.2	1.00	1.36	1.49	1.56	1.60	1.33
30.0	1.00	1.39	1.52	1.59	1.38	1.14
33.2	1.00	1.41	1.54	1.61	1.27	1.05
49.3	1.00	1.48	1.61	1.15	0.90	0.74
50.0	1.00	1.48	1.59	1.14	0.89	0.74
75.0	1.00	1.56	1.14	0.81	0.63	0.52
97.7	1.00	1.60	0.92	0.65	0.51	0.42
100.0	1.00	1.57	0.90	0.64	0.50	0.41
Em/Ei cr		97.67	49.33	33.22	25.17	20.33

tratout   Fri Dec 18 13:08:37 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO = ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

Ef / Em = 50.0   Vf = 0.70   max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

Em/Ei	ti / R = 0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.12	1.20	1.27	1.32	1.36
5.0	1.00	1.14	1.23	1.30	1.36	1.40
5.9	1.00	1.16	1.27	1.34	1.40	1.44
7.5	1.00	1.20	1.32	1.40	1.46	1.50
10.0	1.00	1.25	1.38	1.46	1.52	1.56
10.8	1.00	1.26	1.39	1.48	1.54	1.58
11.9	1.00	1.28	1.42	1.50	1.56	1.60
13.3	1.00	1.30	1.44	1.52	1.58	1.62
15.0	1.00	1.33	1.47	1.55	1.60	1.64
17.3	1.00	1.35	1.50	1.58	1.63	1.67
20.0	1.00	1.38	1.53	1.61	1.66	1.70
20.6	1.00	1.39	1.53	1.61	1.67	1.70
25.5	1.00	1.43	1.58	1.66	1.71	1.41
30.0	1.00	1.47	1.61	1.69	1.49	1.23
33.7	1.00	1.49	1.63	1.71	1.35	1.11
50.0	1.00	1.57	1.71	1.22	0.96	0.79
50.0	1.00	1.57	1.71	1.22	0.96	0.79
75.0	1.00	1.65	1.22	0.87	0.68	0.56
99.0	1.00	1.71	0.97	0.69	0.54	0.44
100.0	1.00	1.69	0.96	0.68	0.54	0.44
Em/Ei cr		99.00	50.00	33.67	25.50	20.60

tratout Fri Dec 18 13:08:42 1992 1

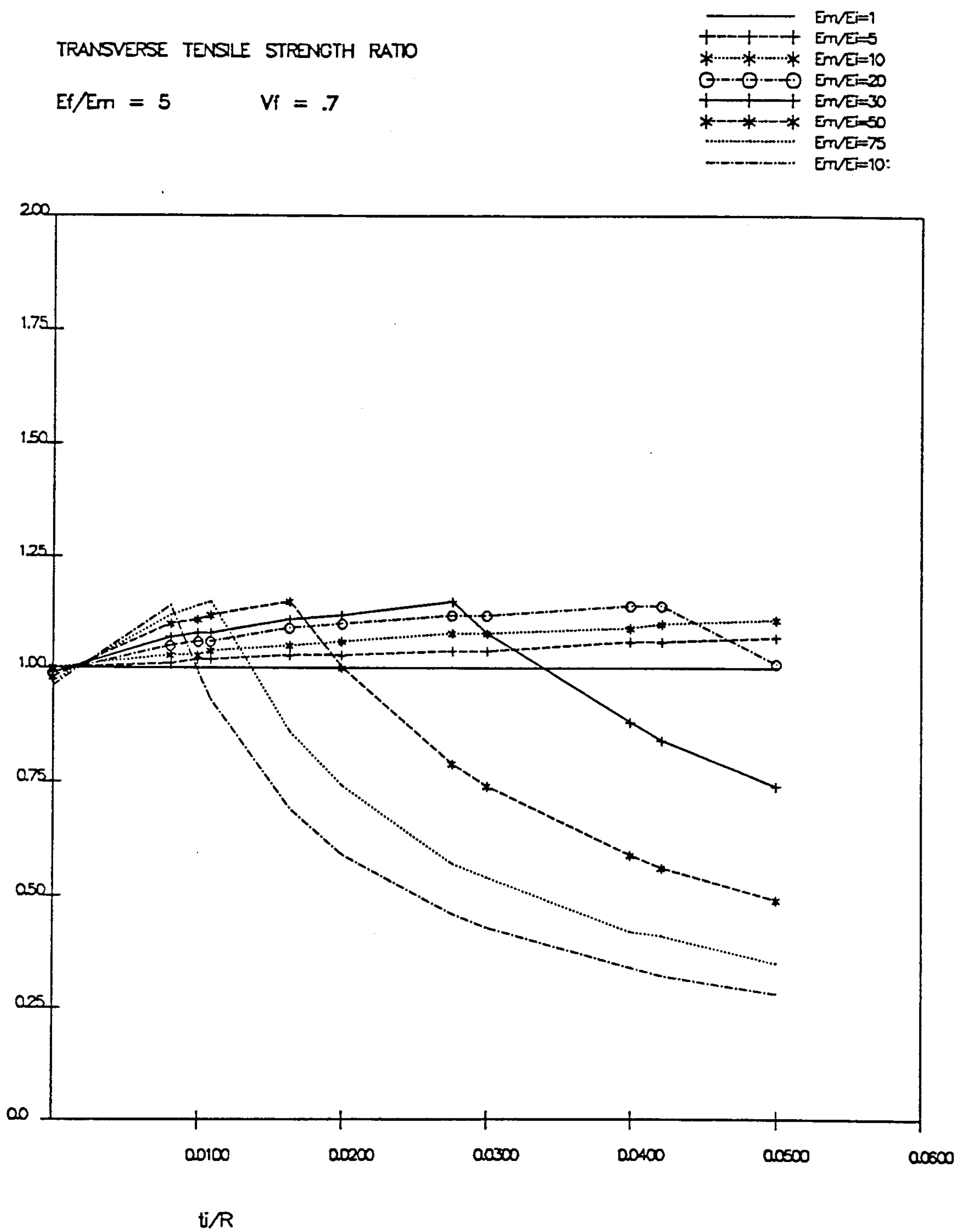
RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

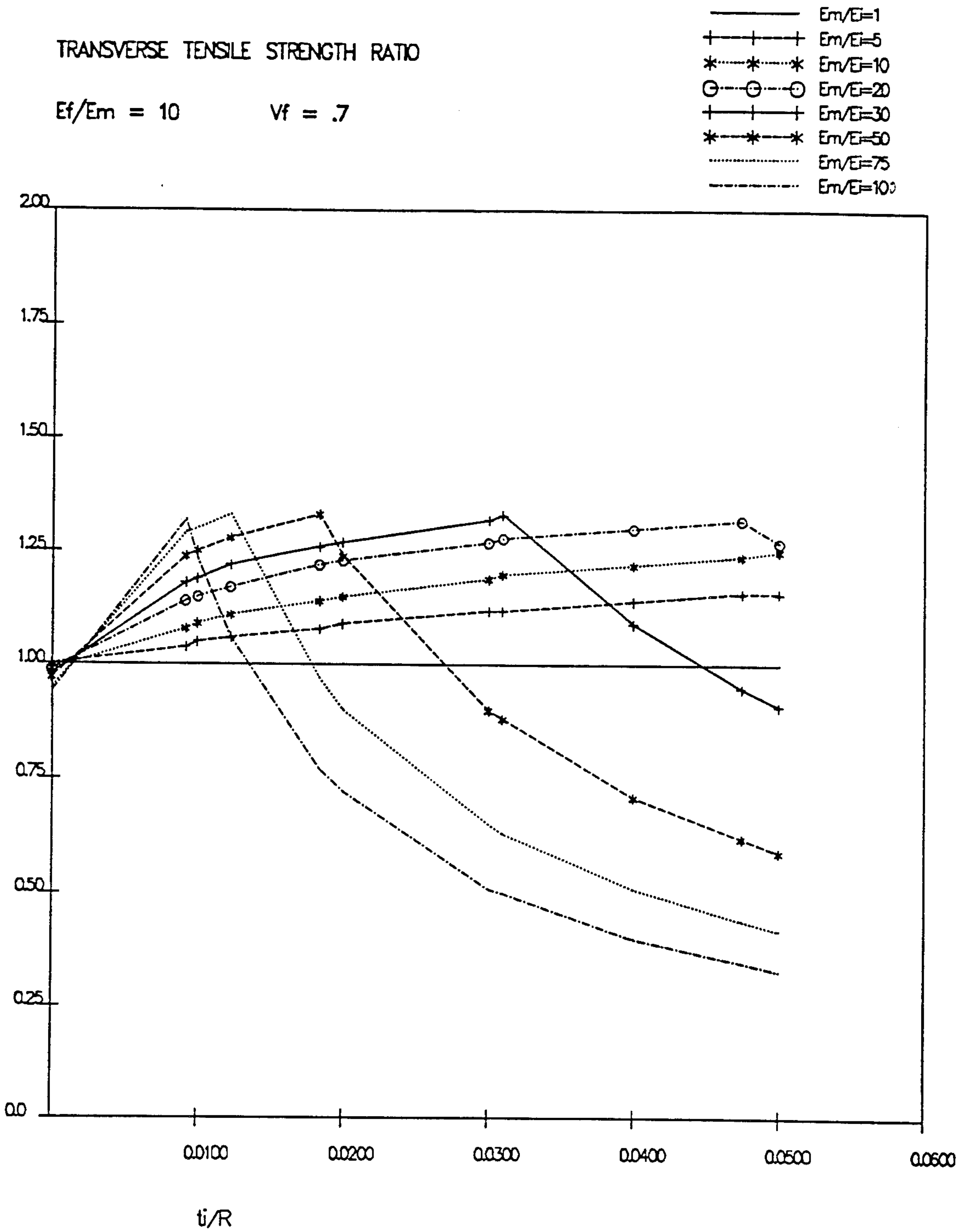
TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase to transverse tensile strength without interphase

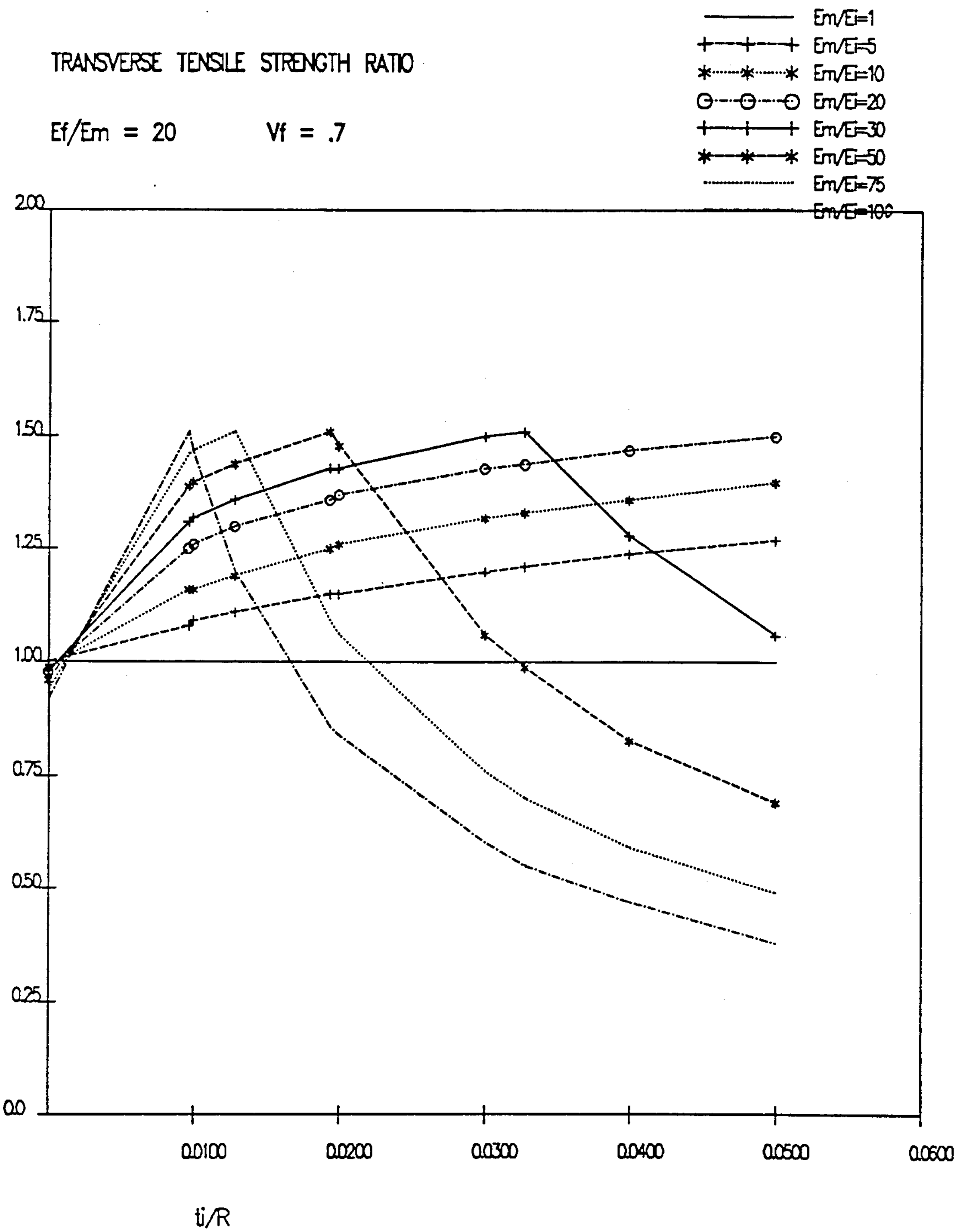
Ef / Em =100.0 Vf = 0.70 max ti/R = 0.059

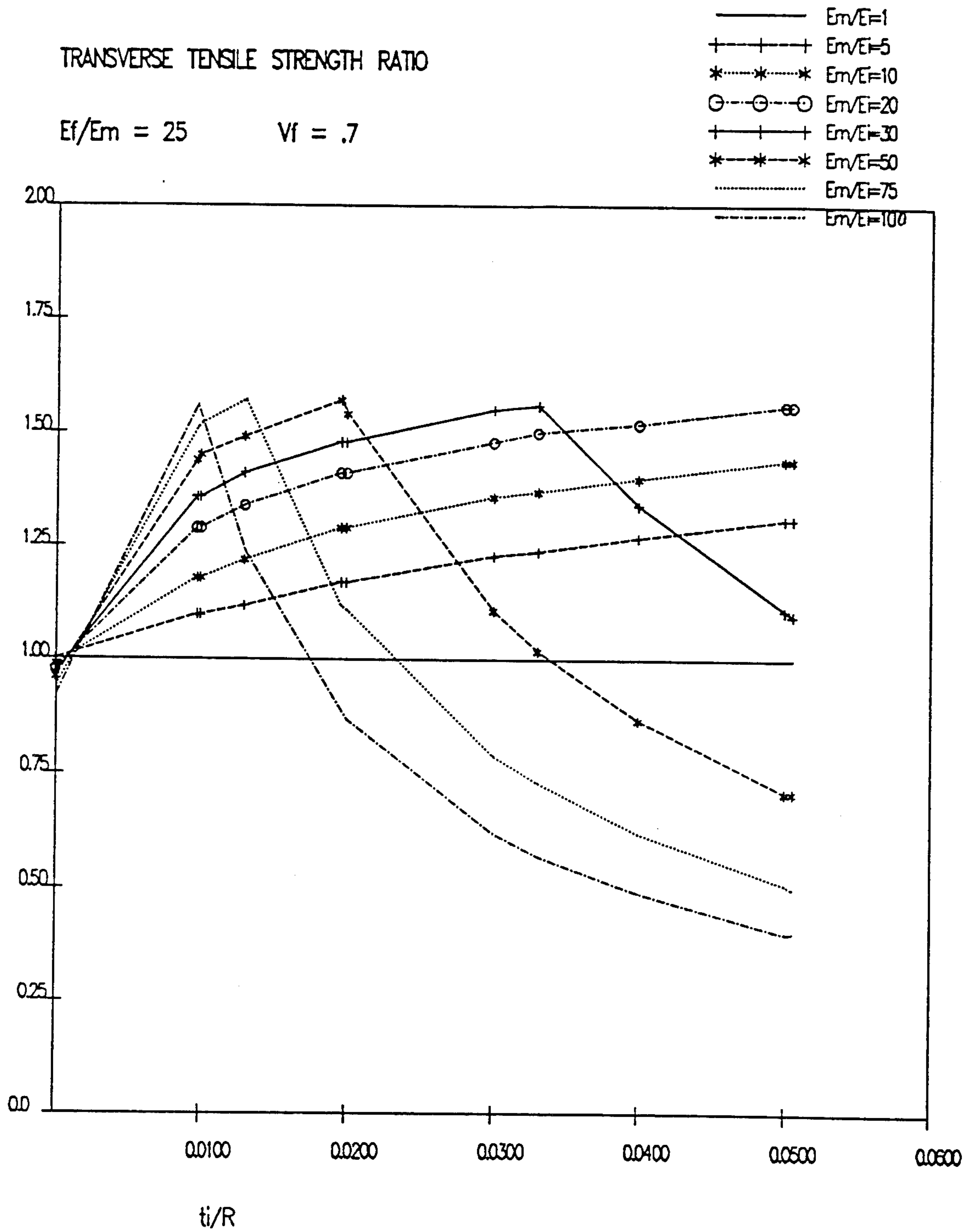
TRANSVERSE TENSILE STRENGTH RATIO

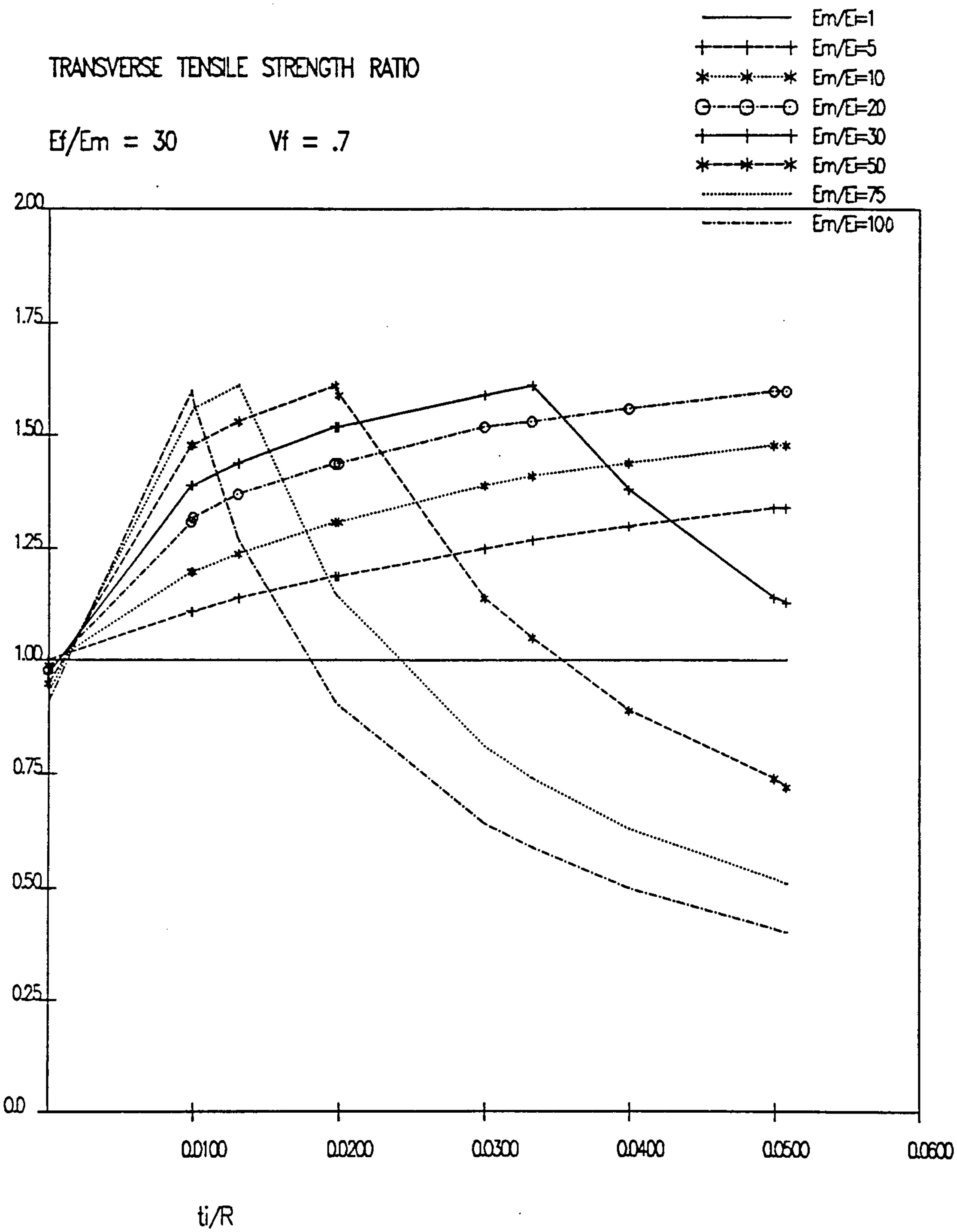
Em/Ei	ti / R 0.00	0.01	0.02	0.03	0.04	0.05
1.0	1.00	1.00	1.00	1.00	1.00	1.00
4.3	1.00	1.14	1.24	1.32	1.38	1.43
5.0	1.00	1.16	1.28	1.36	1.42	1.47
5.9	1.00	1.19	1.32	1.40	1.47	1.52
7.6	1.00	1.24	1.37	1.46	1.53	1.58
10.0	1.00	1.29	1.44	1.53	1.60	1.65
10.9	1.00	1.31	1.46	1.55	1.62	1.66
12.0	1.00	1.33	1.49	1.58	1.64	1.69
13.4	1.00	1.36	1.51	1.60	1.67	1.71
15.1	1.00	1.38	1.54	1.63	1.69	1.74
17.5	1.00	1.42	1.58	1.67	1.72	1.77
20.0	1.00	1.45	1.61	1.69	1.75	1.79
20.8	1.00	1.46	1.62	1.70	1.76	1.80
25.8	1.00	1.50	1.66	1.75	1.81	1.49
30.0	1.00	1.54	1.70	1.78	1.58	1.31
34.0	1.00	1.57	1.72	1.81	1.42	1.17
50.0	1.00	1.65	1.81	1.30	1.02	0.84
50.5	1.00	1.66	1.81	1.29	1.01	0.83
75.0	1.00	1.74	1.30	0.92	0.72	0.59
100.0	1.00	1.81	1.02	0.73	0.57	0.47
100.0	1.00	1.81	1.02	0.73	0.57	0.47
Em/Ei cr		100.00	50.50	34.00	25.75	20.80

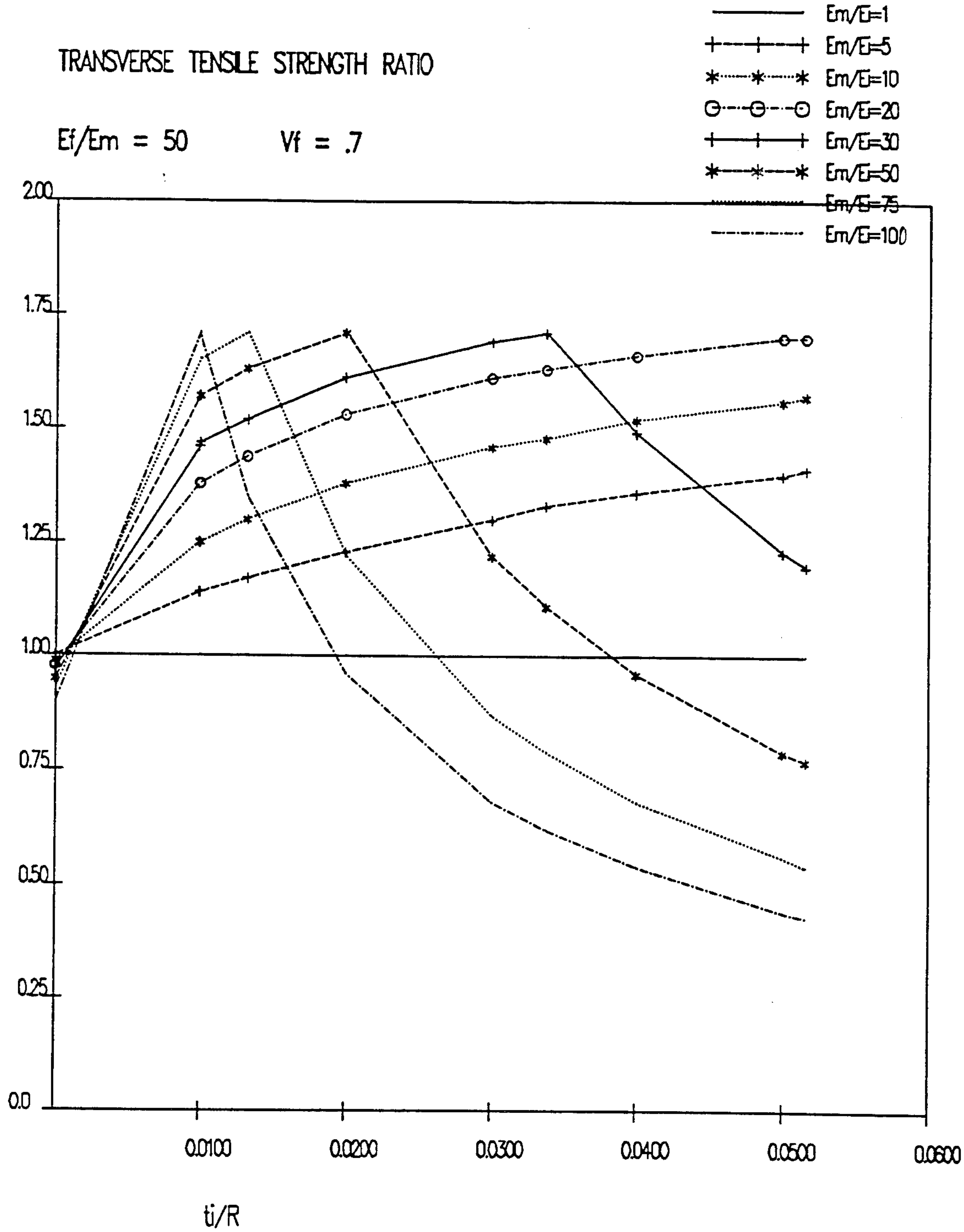

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 5 Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=10:
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R

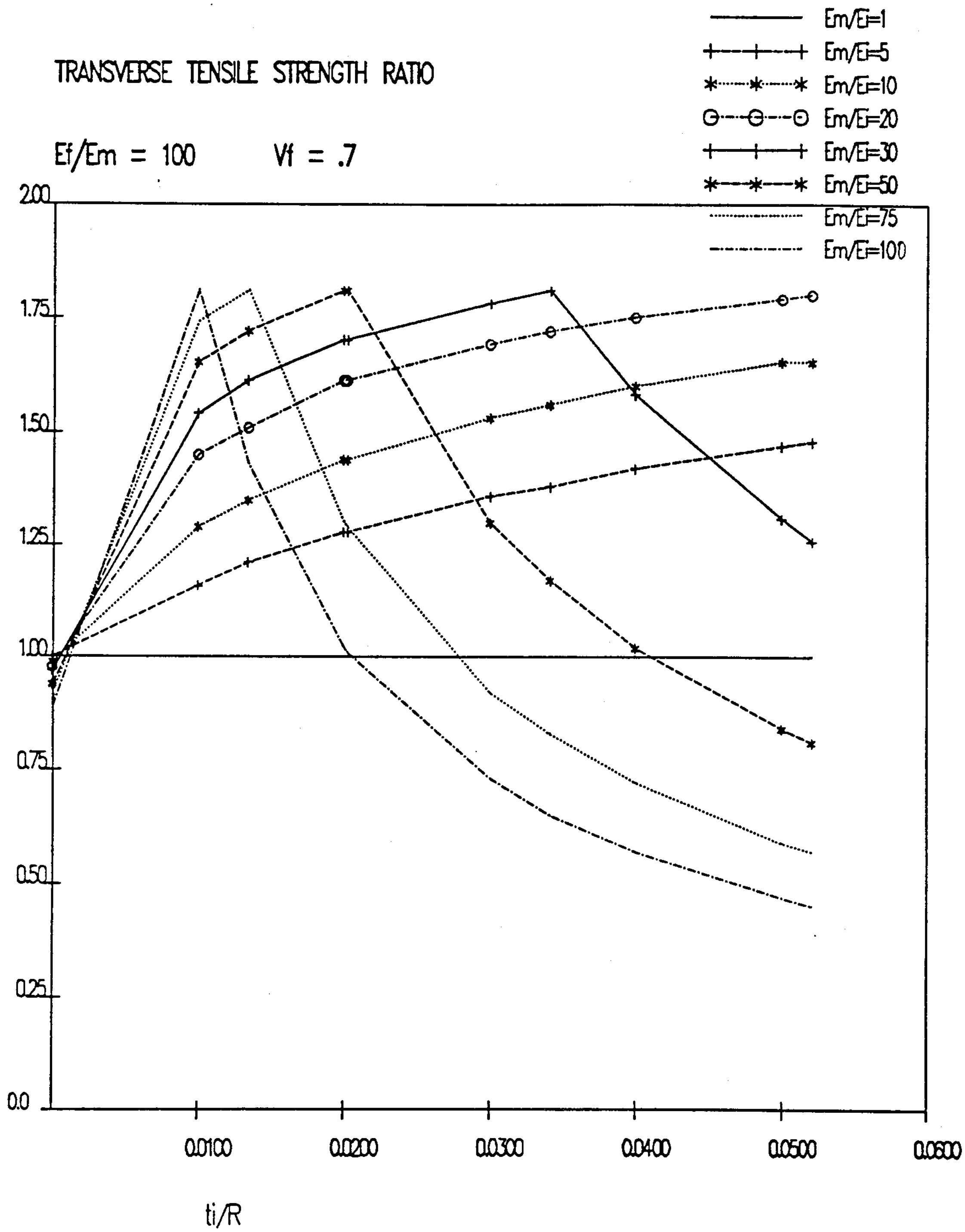

TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 10
Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 20
Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 25
Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 30
Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R


TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 50
Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R



TRANSVERSE TENSILE STRENGTH RATIO
Ef/Em = 100 Vf = .7
Em/Ei=1
Em/Ei=5
Em/Ei=10
Em/Ei=20
Em/Ei=30
Em/Ei=50
Em/Ei=75
Em/Ei=100
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.0
0.0100
0.0200
0.0300
0.0400
0.0500
0.0600
ti/R

tratout   Fri Dec 18 15:42:05 1992   1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 5.0   Vf = 0.70   max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	1.00	0.99	0.99	0.98	0.97	0.96
0.008	1.00	1.01	1.03	1.05	1.07	1.10	1.12	1.14
0.010	1.00	1.02	1.03	1.06	1.08	1.11	1.14	0.99
0.011	1.00	1.02	1.04	1.06	1.08	1.12	1.15	0.93
0.016	1.00	1.03	1.05	1.09	1.11	1.15	0.86	0.69
0.020	1.00	1.03	1.06	1.10	1.12	1.00	0.74	0.59
0.028	1.00	1.04	1.08	1.12	1.15	0.79	0.57	0.46
0.030	1.00	1.04	1.08	1.12	1.08	0.74	0.54	0.43
0.040	1.00	1.06	1.09	1.14	0.88	0.59	0.42	0.34
0.042	1.00	1.06	1.10	1.14	0.84	0.56	0.41	0.32
0.050	1.00	1.07	1.11	1.01	0.74	0.49	0.35	0.28
ti/R cr		0.200	0.089	0.042	0.028	0.016	0.011	0.008

tratout Fri Dec 18 15:42:09 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 10.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.99	0.98	0.97	0.95	0.94
0.009	1.00	1.04	1.08	1.14	1.18	1.24	1.29	1.32
0.010	1.00	1.05	1.09	1.15	1.19	1.25	1.30	1.23
0.012	1.00	1.06	1.11	1.17	1.22	1.28	1.33	1.06
0.018	1.00	1.08	1.14	1.22	1.26	1.33	0.97	0.77
0.020	1.00	1.09	1.15	1.23	1.27	1.24	0.90	0.72
0.030	1.00	1.12	1.19	1.27	1.32	0.90	0.65	0.51
0.031	1.00	1.12	1.20	1.28	1.33	0.88	0.63	0.50
0.040	1.00	1.14	1.22	1.30	1.09	0.71	0.51	0.40
0.047	1.00	1.16	1.24	1.32	0.95	0.62	0.44	0.35
0.050	1.00	1.16	1.25	1.27	0.91	0.59	0.42	0.33
ti/R cr		0.225	0.100	0.047	0.031	0.018	0.012	0.009

tratout Fri Dec 18 15:42:13 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 20.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

ti/R	Em / Ei 1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.98	0.96	0.94	0.92
0.010	1.00	1.08	1.16	1.25	1.31	1.39	1.46	1.51
0.010	1.00	1.09	1.16	1.26	1.32	1.40	1.47	1.46
0.013	1.00	1.11	1.19	1.30	1.36	1.44	1.51	1.20
0.019	1.00	1.15	1.25	1.36	1.43	1.51	1.09	0.86
0.020	1.00	1.15	1.26	1.37	1.43	1.48	1.06	0.84
0.030	1.00	1.20	1.32	1.43	1.50	1.06	0.76	0.60
0.033	1.00	1.21	1.33	1.44	1.51	0.99	0.70	0.55
0.040	1.00	1.24	1.36	1.47	1.28	0.83	0.59	0.47
0.050	1.00	1.27	1.40	1.50	1.06	0.69	0.49	0.38
0.050	1.00	1.27	1.40	1.50	1.06	0.69	0.49	0.38
ti/R cr		0.237	0.106	0.050	0.033	0.019	0.013	0.010

tratout Fri Dec 18 15:42:15 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 25.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH PATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.97	0.96	0.94	0.92
0.010	1.00	1.10	1.18	1.29	1.36	1.44	1.51	1.56
0.010	1.00	1.10	1.18	1.29	1.36	1.45	1.52	1.53
0.013	1.00	1.12	1.22	1.34	1.41	1.49	1.57	1.24
0.020	1.00	1.17	1.29	1.41	1.48	1.57	1.12	0.89
0.020	1.00	1.17	1.29	1.41	1.48	1.54	1.11	0.87
0.030	1.00	1.23	1.36	1.48	1.55	1.11	0.79	0.62
0.033	1.00	1.24	1.37	1.50	1.56	1.02	0.73	0.57
0.040	1.00	1.27	1.40	1.52	1.34	0.87	0.62	0.49
0.050	1.00	1.31	1.44	1.56	1.11	0.71	0.51	0.40
0.051	1.00	1.31	1.44	1.56	1.10	0.71	0.50	0.40
ti/R cr		0.240	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 15:42:21 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 30.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.97	0.95	0.93	0.91
0.010	1.00	1.11	1.20	1.31	1.39	1.48	1.55	1.60
0.010	1.00	1.11	1.20	1.32	1.39	1.48	1.56	1.57
0.013	1.00	1.14	1.24	1.37	1.44	1.53	1.61	1.27
0.020	1.00	1.19	1.31	1.44	1.52	1.61	1.15	0.91
0.020	1.00	1.19	1.31	1.44	1.52	1.59	1.14	0.90
0.030	1.00	1.25	1.39	1.52	1.59	1.14	0.81	0.64
0.033	1.00	1.27	1.41	1.53	1.61	1.05	0.74	0.59
0.040	1.00	1.30	1.44	1.56	1.38	0.89	0.63	0.50
0.050	1.00	1.34	1.48	1.60	1.14	0.74	0.52	0.41
0.051	1.00	1.34	1.48	1.60	1.13	0.72	0.51	0.40
ti/R cr		0.242	0.107	0.051	0.033	0.020	0.013	0.010

tratout Fri Dec 18 15:42:26 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em = 50.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.97	0.95	0.93	0.90
0.010	1.00	1.14	1.25	1.38	1.46	1.57	1.65	1.71
0.010	1.00	1.14	1.25	1.38	1.47	1.57	1.65	1.69
0.013	1.00	1.17	1.30	1.44	1.52	1.63	1.71	1.35
0.020	1.00	1.23	1.38	1.53	1.61	1.71	1.22	0.96
0.020	1.00	1.23	1.38	1.53	1.61	1.71	1.22	0.96
0.030	1.00	1.30	1.46	1.61	1.69	1.22	0.87	0.68
0.034	1.00	1.33	1.48	1.63	1.71	1.11	0.79	0.62
0.040	1.00	1.36	1.52	1.66	1.49	0.96	0.68	0.54
0.050	1.00	1.40	1.56	1.70	1.23	0.79	0.56	0.44
0.052	1.00	1.41	1.57	1.70	1.20	0.77	0.54	0.43
ti/R cr		0.245	0.109	0.052	0.034	0.020	0.013	0.010

tratout Fri Dec 18 15:42:31 1992 1

RESULTS FOR ONE DIMENSIONAL THEORY FOR THE TRANSVERSE
TENSILE STRESS INCLUDING THE EFFECT OF THE INTERPHASE

TRANSVERSE TENSILE STRENGTH RATIO =
ratio of transverse tensile strength with interphase
to transverse tensile strength without interphase

Ef / Em =100.0 Vf = 0.70 max ti/R = 0.059

TRANSVERSE TENSILE STRENGTH RATIO

	Em / Ei							
ti/R	1.0	5.0	10.0	20.0	30.0	50.0	75.0	100.0
0.000	1.00	1.00	0.99	0.98	0.97	0.94	0.92	0.89
0.010	1.00	1.16	1.29	1.45	1.54	1.65	1.74	1.81
0.010	1.00	1.16	1.29	1.45	1.54	1.65	1.74	1.81
0.013	1.00	1.21	1.35	1.51	1.61	1.72	1.81	1.43
0.020	1.00	1.28	1.44	1.61	1.70	1.81	1.30	1.02
0.020	1.00	1.28	1.44	1.61	1.70	1.81	1.29	1.01
0.030	1.00	1.36	1.53	1.69	1.78	1.30	0.92	0.73
0.034	1.00	1.38	1.56	1.72	1.81	1.17	0.83	0.65
0.040	1.00	1.42	1.60	1.75	1.58	1.02	0.72	0.57
0.050	1.00	1.47	1.65	1.79	1.31	0.84	0.59	0.47
0.052	1.00	1.48	1.65	1.80	1.26	0.81	0.57	0.45
ti/R cr		0.248	0.110	0.052	0.034	0.020	0.013	0.010

DISTRIBUTION LIST

No. of Copies

Office of Naval Technology.. 1
Attn: W. King, ONT-212
800 N. Quincy Street
Arlington, VA 22217

Office of Naval Research.. 1
Attn: A. K. Vasudevan, Code 1216
800 N. Quincy Street
Arlington, VA 22217

Office of Naval Research.. 1
Attn: Y. Rajapakse, Code 1132SM
800 N. Quincy Street
Arlington, VA 22217

Director.. 1
Naval Research Laboratory
Attn: Dr. R. Badaliance
4555 Overlook Avenue, S.W.
Washington, D.C. 20375

Director.. 1
Naval Research Laboratory
Attn: Dr. I. Wolock, Code 6383
4555 Overlook Avenue, S.W.
Washington, D.C. 20375-5000

Director.. 1
Naval Research Laboratory
Attn: C. Poranski, Code 6122
4555 Overlook Avenue, S.W.
Washington, D.C. 20375-5000

Commander.. 1
Naval Air Systems Command
Attn: AIR-530
Washington, D.C. 20361

Commander.. 1
Naval Air Systems Command
Attn: AIR-5302
Washington, D.C. 20361

Commander.. 1
Naval Air Systems Command
Attn: AIR-53021
Washington, D.C. 20361

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Commander Naval Air Systems Command Attn: AIR-53022 Washington, D.C. 20361	1
Commander Naval Air Systems Command Attn: AIR-53023 Washington, D.C. 20361	1
Commander Naval Air Systems Command Attn: AIR-5304 Washington, D.C. 20361	1
Commander Naval Air Systems Command Attn: AIR-530T Washington, D.C. 20361	1
Commander Naval Sea Systems Command Attn: Sea-05R Washington, D.C. 20362-5101	1
Commander Naval Weapons Center Attn: K. Bailey, Code 338 China Lake, CA 93355	1
Commander Naval Weapons Center Attn: J. E. Diamond, Code 338 China Lake, CA 93355	1
Commanding Officer Naval Ship Engineering Center Attn: NSEC 6101E Arlington, VA 20360	1
Commander David Taylor Research Center Attn: R. Rockwell, Code 1720-6 Bethesda, MD 20084	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Commander David Taylor Research Center Attn: A. Macander, Code 1720 Bethesda, MD 20084	1
Commander David Taylor Research Center Attn: E. T. Camponeschi, Code 2844 Annapolis, MD 21402	1
Commander David Taylor Research Center Attn: R. Crane, Code 2802 Annapolis, MD 21402	1
Commander David Taylor Research Center Attn: H. Edelstein, Code 2870 Annapolis, MD 21401	1
Commander Naval Surface Weapons Center Attn: Dr. J. M. Augl 10901 New Hampshire Avenue Silver Spring, MD 20903-5000	1
Commander Naval Surface Weapons Center Attn: Dr. J. Goff, R34 White Oak Laboratory Silver Spring, MD 20910	1
Commander Naval Aviation Depot Attn: N. Amdur, Code 342/N NAS, Alameda, CA 94501	1
Commander Naval Aviation Depot Attn: J. Meyers, Code 35110 MCAS, Cherry Point, NC 28533-5030	1
Commander Naval Aviation Depot Attn: J. Fuss, Code 35430 MCAS, Cherry Point, NC 28533-5030	1

DISTRIBUTION LIST

DEVELOPMENT

No. of Copies

Commander... 1
Naval Aviation Depot
Attn: J. Gresham, Code 35210
MCAS, Cherry Point, NC 28533-5030

Commander... 1
Naval Aviation Depot
Attn: M. Linn, Code 340
NAS, Jacksonville, FL 32212-0016

Commander... 1
Naval Aviation Depot
Attn: J. Deans, Code 31310, Bldg. V88
NAS, Norfolk, VA 23511-5899

Commander... 1
Naval Aviation Depot
Attn: H. Jarrett, Code 32220
NAS, Norfolk, VA 23511-5899

Commander... 1
Naval Aviation Depot
Attn: H. Sommerfleck, Code 36030
NAS, Norfolk, VA 23511-5899

Commanding Officer.. 1
Naval Aviation Depot
Attn: D. Perl, Code 343
NAS, North Island, San Diego, CA 92135-5112

Commanding Officer.. 1
Naval Aviation Depot
Attn: M. Williams, Code 31327
NAS, North Island, San Diego, CA 92135-5112

Commanding Officer.. 1
Naval Aviation Depot
Attn: D. Knapp, Code 342
NAS, Pensacola, FL 32508-5300

Commander... 1
United States Naval Academy
Attn: Mechanical Engineering Dept.
Annapolis, MD 21402

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Commander U.S. Naval Postgraduate School Attn: Professor R. Ball Monterey, CA 93943	1
Commander U.S. Naval Postgraduate School Attn: Professor M. H. Bank, Code 67BP Monterey, CA 93943	1
Commander U.S. Naval Postgraduate School Attn: Technical Library Monterey, CA 93943	1
Commander U.S. Naval Postgraduate School Attn: Dr. E. Robert Wood, Code 67 Monterey, CA 93943	1
Department of the Air Force Attn: Dr. M. Salkind Building 410 Boiling Air Force Base Washington, D.C. 20331	1
Department of the Air Force Attn: Dr. Spencer Wu AFOSR/NA Boiling Air Force Base Washington, D.C. 20331	1
Commanding Officer Wright Research and Development Center Attn: FIBAC/R. Holzwarth Wright Patterson Air Force Base, OH 45433-6553	1
Commanding Officer Wright Research and Development Center Attn: FIB/R. Bader Wright Patterson Air Force Base, OH 45433-6553	1

DISTRIBUTION LIST

DEVELOPMENT

No. of Copies

Commanding Officer.. 1
Wright Research and Development Center
Attn: FIBC/C. Ramsey
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: FIBEC/Dr. G. Sendeckyj
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: FIBR/H. F. Wolfe
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: FIBA/L. Kelly
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLBM/Dr. J. Whitney
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLSE/F. Fecheck
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLBM/Dr. M. Knight
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLB/F. Cherry
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLSE/T. Reinhart
Wright Patterson Air Force Base, OH 45433-6553

DISTRIBUTION LIST

DEVELOPMENT

No. of Copies

Commanding Officer.. 1
Wright Research and Development Center
Attn: MLTN/R. C. Tomashot
Wright Patterson Air Force Base, OH 45433-6553

Commanding Officer.. 1
Warner Robbins Air Logistics Command
Attn: T. F. Christian, MMSRD
Robbins Air Force Base, GA 30198

Commanding Officer.. 1
Warner Robbins Air Logistics Command
Attn: W. Schweinberg
WRALC/TIEDD, Bldg. 300
Robbins Air Force Base, GA 30198

Commanding Officer.. 1
Picatinny Arsenal
PLASTEC
Attn: Librarian, Code DRDAR-SCM-0, Bldg. 351N
Dover, NJ 07801

Commanding Officer.. 1
U.S. Army Air Mobility R&D Lab
Attn: H. Reddick
Fort Eustis, VA 23604

Commanding Officer.. 1
U.S. Army Aviation Applied Technology Directorate
Attn: T. E. Condon
SAVRT/TY-ASR
Fort Eustis, VA 23604-5577

Commanding Officer.. 1
U.S. Army Aviation Applied Technology Directorate
Attn: Drew Orlino
SAVRT/TY-ATS
Fort Eustis, VA 23604-5577

Commanding Officer.. 1
U.S. Army Materials and Mechanical Research Center
Attn: D. Oplinger, SLCMT-MS
Watertown, MA 02171-0001

Commanding Officer.. 1
U.S. Army Research Office
Durham, NC 27701

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Commanding Officer Advanced Systems Research and Analysis Office-ASRAO Attn: Library, M/S 219-3 Ames Research Center Moffett Field, CA 94035-1000	1
Commanding Officer U.S. Army R&T Laboratory (ARRADCOM) Attn: K. Abelson Building 182 Dover, NJ 07801	1
Commanding Officer U.S. Army R&T Laboratory (ARRADCOM) Attn: R. Bonk Building 182 Dover, NJ 07801	1
Commanding Officer U.S. Army Applied Technology Lab Attn: G. McAllister USARTL, (AVRADCOM) Fort Eustis, VA 23604-5418	1
Commanding Officer U.S. Army Applied Technology Lab Attn: J. Waller USARTL, (AVRADCOM) Fort Eustis, VA 23604-5418	1
NASA Headquarters Attn: G. Seidel OAST-Code RM Washington, D.C. 20546	1
Administrator National Aeronautics and Space Administration Attn: Airframes Branch, FS 120 Washington, D.C. 20546	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Dr. C. P. Blankenship, M/S-188M Hampton, VA 23665-5225	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Mr. C. E. Harris, M/S 188E Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Dr. J. Starnes, M/S 190 Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Dr. M. Mikulas, M/S 190 Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Mr. W. T. Freeman, M/S 241 Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Mr. J. W. Deaton, M/S 188A Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Mr. J. Davis, M/S 243/STPO Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Dr. R. Price Hampton, VA 23665-5225	1
Administrator National Aeronautics and Space Administration Langley Research Center Attn: Dr. G. L. Roderick Hampton, VA 23665-5225	1

DISTRIBUTION LIST

DEVELOPMENT

No. of Copies

Administrator.. 1
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Attn: R. Schwinghamer, S&E-ASTN-M
Huntsville, AL 35812

Administrator.. 1
National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Attn: Technical Library
Huntsville, AL 35812

Administrator.. 1
National Aeronautics and Space Administration
Lewis Research Center
Attn: Dr. C. Chamis, M/S-49-6
21000 Brookpark Road
Cleveland, OH 44153

Administrator.. 1
National Aeronautics and Space Administration
Lewis Research Center
Attn: M. Hershberg, M/S 49-6
21000 Brookpark Road
Cleveland, OH 44153

Administrator.. 1
National Aeronautics and Space Administration
Lewis Research Center
Attn: Technical Library
21000 Brookpark Road
Cleveland, OH 44153

Administrator.. 2
Defense Technical Information Center
Bldg. #5, Cameron Station
Alexandria, VA 22314

Federal Aviation Administration.................................... 1
Attn: Mr. J. R. Soderquist, AIR-103
800 Independence Avenue, S.W.
Washington, D.C. 20591

Federal Aviation Administration.................................... 1
Attn: Mr. L. Neri, Code ACD-210
Technical Center
Atlantic City, NJ 08405

DISTRIBUTION LIST

DEVELOPMENT

No. of Copies

Federal Adviation Administration.................................... 1
Attn: C. Caiafa, Code ACT-330
Technical Center
Atlantic City, NJ 08405

AVCO Specialty Materials - Textron.................................. 1
Attn: Mr. William F. Grant
Specialty Materials Division
2 Industrial Avenue
Lowell, MA 01851

AVCO Specialty Materials - Textron.................................. 1
Attn: J. Hemshaw
Specialty Materials Division
2 Industrial Avenue
Lowell, MA 01851

Beech Aircraft Corporation.. 1
Attn: Mr. M. P. Djuric
Kellogg St. and Webb Road
Wichita, KS 67201

Bell Helicopter/Textron Inc... 1
Attn: Technical Library
P.O. Box 482
Fort Worth, TX 76101

Bell Helicopter/Textron Inc... 1
Attn: Mr. D. Reisdorfer, M/S 11
P.O. Box 482
Fort Worth, TX 76101

Bell Helicopter/Textron Inc... 1
Attn: Mr. M. K. Stevenson, M/S 12
P.O. Box 482
Fort Worth, TX 76101

Boeing Helicopter Company... 1
Boeing Defense and Space Group
Attn: Dr. C. K. Gunther, M/S P30-30
P.O. Box 16858
Philadelphia, PA 19142-0858

Boeing Helicopter Company... 1
Attn: Technical Library
P.O. Box 16858
Philadelphia, PA 19142

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Boeing Helicopter Company Attn: Mr. D. Hart P.O. Box 16858 Philadelphia, PA 19142	1
Boeing Helicopter Company Attn: Mr. R. L. Pinckney P.O. Box 16858 Philadelphia, PA 19142	1
Boeing Helicopter Company Attn: Mr. C. Albrecht, M/S P32-38 P.O. Box 16858 Philadelphia, PA 19142	1
Boeing Helicopter Company Attn: Mr. Brian Lake, M/S P30-18 P.O. Box 16858 Philadelphia, PA 19142	1
Boeing Company Attn: Technical Library P.O. Box 3707 Seattle, WA 98124-2207	1
Boeing Company Attn: Mr. R. Horton, M/S 3304 P.O. Box 3707 Seattle, WA 98124-2207	1
Boeing Company Attn: Mr. J. Quinlivan, M/S 6N-21 P.O. Box 3707 Seattle, WA 98124-2207	1
Boeing Military Aircraft Company Attn: Technical Library P.O. Box 20746 Wichita, KS 67277-7730	1
Boeing Military Aircraft Company Attn: Mr. J. Avery P.O. Box 20746 Wichita, KS 67277-7730	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Boeing Military Aircraft Company Attn: Mr. R. Waner P.O. Box 20746 Wichita, KS 67277-7730	1
Boeing Military Airplane Company Attn: Mr. J. Luding, M/S K3216 P.O. Box 20746 Wichita, KS 67277-7730	1
Boeing Military Airplane Company Attn: Mr. R. M. Mayle, M/S K06-72 P.O. Box 20746 Wichita, KS 67277-7730	1
General Dynamics/Convair Division Space Systems Division Attn: Technical Library P.O. Box 85990 San Diego, CA 92138	1
General Dynamics/Convair Division Space Systems Division Attn: Craig Rix, MZ-23-8443 P.O. Box 85990 San Diego, CA 92138	1
General Dynamics/Convair Division Space Systems Division Attn: Mr. D. R. Dunbar P.O. Box 85990 San Diego, CA 92138	1
General Dynamics/Fort Worth Division Attn: Technical Library P.O. Box 748 Fort Worth, TX 76101	1
General Dynamics/Fort Worth Division Attn: Mr. T. Kearns, M/S 6217 P.O. Box 748 Fort Worth, TX 76101	1
General Dynamics/Fort Worth Division Attn: Mr. J. A. Fant P.O. Box 748-MZ 2884 Fort Worth, TX 76101	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
General Dynamics/Fort Worth Division Attn: Dr. G. Law, Composite Structures Certification P.O. Box 748 Fort Worth, TX 76101	1
General Electric Company Attn: Technical Library 1 Neumann Way Cincinnati, OH 45215	1
General Electric Company Attn: Mr. S. Johnson 1 Neumann Way Cincinnati, OH 45215	1
General Electric Company Attn: Mr. A. W. Kim 1 Neumann Way Cincinnati, OH 45215	1
General Electric Company Attn: Technical Library P.O. Box 8555 Philadelphia, PA 19101	1
General Electric Company Attn: Mr. A. Garber P.O. Box 8555-M4018 Philadelphia, PA 19101	1
General Electric Company Attn: Mr. C. Zweben P.O. Box 8555-M4018 Philadelphia, PA 19101	1
General Electric Company Attn: Dr. B. Rodini P.O. Box 8555-M4018 Philadelphia, PA 19101	1
Grumman Aircraft Systems Attn: Technical Library South Oyster Bay Road Bethpage, Long Island, NY 11714	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Grumman Aircraft Systems Attn: Mr. R. Hadcock, Advanced Materials South Oyster Bay Road Bethpage, Long Island, NY 11714	1
Grumman Aircraft Systems Attn: Mr. J. Bruno, B44-35 South Oyster Bay Road Bethpage, Long Island, NY 11714	1
Grumman Aircraft Systems Attn: Mr. S. Dastin South Oyster Bay Road Bethpage, Long Island, NY 11714	1
Lockheed Aeronautical Systems Company Attn: Technical Library P.O. Box 551 Burbank, CA 91520	1
Lockheed Aeronautical Systems Company Attn: C. W. Schneider D/70-03, B-369, P/B-6 P.O. Box 551 Burbank, CA 91520	1
Lockheed Aeronautic Systems Company Attn: Mr. D. E. Pettit Rye Canyon Research Lab Burbank, CA 91520	1
Lockheed Aeronautic Systems Company Attn: Mr. R. C. Young Rye Canyon Research Lab Burbank, CA 91520	1
Lockheed Aeronautic Systems Company Attn: Mr. E. K. Walker, Dept. 76-02, B63, Plt. A1 P.O. Box 551 Burbank, CA 91520	1
Lockheed Aeronautic Systems Company Attn: C. F. Griffin, Dept. 76-24 Advanced Structures Technology Dept. Burbank, CA 91520	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Lockheed-Georgia Company Attn: Technical Library 86 South Cobb Drive Marietta, GA 30063	1
Lockheed-Georgia Company Attn: Technical Information Dept. 72-34, Zone 26 Marietta, GA 30063	1
Lockheed-Missile and Space Company Attn: Technical Library 1111 Lockheed Way Sunnyvale, CA 94088	1
Lockheed-Missile and Space Company Attn: Mr. J. A. Bailie, Dept. 81-12, B154 P.O. Box 504 1111 Lockheed Way Sunnyvale, CA 94088	1
LTV Aerospace and Defense Company Vought Aeroproducts Division Attn: Technical Library P.O. Box 655907 Dallas, TX 75265-5907	1
LTV Aerospace and Defense Company Vought Aeroproducts Division Attn: Mr. J. Pimm, M/S 194-51 P.O. Box 655907 Dallas, TX 75265-5907	1
LTV Aerospace and Defense Company Vought Missiles and Advanced Programs Division Attn: C. Foreman, Engineering Project Manager P.O. Box 655907 Dallas, TX 75265-5907	1
LTV Aerospace and Defense Company Vought Missiles and Advanced Programs Division Attn: Mr. R. Knight, M/S-TH-83 P.O. Box 650003 Dallas, TX 75265-0003	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
LTV Aircraft Product Group Structures Research and Development Attn: Mr. R. Ely, Technical Project Manager P.O. Box 655907 Dallas, TX 75265-5907	1
McDonnell-Douglas Corporation Attn: Technical Library P.O. Box 516 St. Louis, MO 63166	1
McDonnell-Douglas Corporation Attn: Mr. C. Pingle, Dept. 337, M/S 0644324 P.O. Box 516 St. Louis, MO 63166	1
McDonnell-Douglas Corporation Attn: Mr. D. J. Dorr, Dept. 390, M/S 1021310 P.O. Box 516 St. Louis, MO 63166	1
McDonnell-Douglas Corporation Attn: Mr. C. Saff, Dept. 337, M/S 0341160 P.O. Box 516 St. Louis, MO 63166	1
McDonnell-Douglas Corporation Attn: Mr. T. Hinkel, Dept. 334, M/S 0643063 P.O. Box 516 St. Louis, MO 63166	1
McDonnell-Douglas Corporation Douglas Aircraft Company Attn: Technical Library Mail Code 212-10 Long Beach, CA 90846	1
McDonnell-Douglas Corporation Douglas Aircraft Company Attn: Mr. A. Hawley, Dept. ELH, M/S 212-10 3855 Lakewood Blvd. Long Beach, CA 90846	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
McDonnell-Douglas Corporation Douglas Aircraft Company Attn: Mr. R. Petty, Dept. 1L7, M/S 35-98 3855 Lakewood Blvd. Long Beach, CA 90846	1
McDonnell-Douglas Corporation Douglas Aircraft Company Attn: Mr. Clifford Y. Kam, Dept. EL8, M/S 212-20 Long Beach, CA 90846	1
McDonnell-Douglas Helicopter Company Attn: Technical Library Culver City, CA 90230	1
McDonnell-Douglas Helicopter Company Attn: Mr. R. M. Verette Culver City, CA 90230	1
McDonnell-Douglas Helicopter Company Attn: Technical Library 5000 E. McDowell Road Mesa, AZ 85205	1
McDonnell-Douglas Helicopter Company Attn: Mr. J. K. Sen MS 338, Bldg. 530 5000 E. McDowell Road Mesa, AZ 85205	1
McDonnell-Douglas Helicopter Company Attn: Mr. S. Guymon, M/S B337 5000 E. McDowell Road Mesa, AZ 85205	1
McDonnell-Douglas Astronautics Attn: Technical Library 5301 Bolsa Avenue Huntington Beach, CA 92647	1
McDonnell-Douglas Astronautics Attn: Mr. C. M. Roe 5301 Bolsa Avenue Huntington Beach, CA 92647	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Northrop Aircraft Corporation Attn: Technical Library One Northrop Avenue Hawthorne, CA 90250	1
Northrop Aircraft Corporation Attn: Mr. D. Boldi One Northrop Avenue Hawthorne, CA 90250	1
Northrop Aircraft Corporation Attn: Dr. M. Ratwani One Northrop Avenue Hawthorne, CA 90250	1
Northrop Aircraft Corporation Attn: Mr. B. Butler One Northrop Avenue Hawthorne, CA 90250	1
Northrop Aircraft Corporation Attn: Mr. R. Whitehead, Structures Research One Northrop Avenue Hawthorne, CA 90250	1
Rockwell International/North American Aircraft Division Attn: Technical Library P.O. Box 92098 Los Angeles, CA 90009	1
Rockwell International/North American Aircraft Division Attn: Mr. G. Stewart, Advanced Structures Engineering P.O. Box 92098 Los Angeles, CA 90009	1
Rockwell International/North American Aircraft Division Attn: Mr. A. Sanders P.O. Box 92098 Los Angeles, CA 90009	1
Rockwell International/North American Aircraft Division Attn: Mr. W. O'Brien P.O. Box 92098 Los Angeles, CA 90009	1
Rockwell International/North American Aircraft Division Advanced Technology Program Development Attn: Dr. Lackman P.O. Box 92098 Los Angeles, CA 90009	1

DISTRIBUTION LIST

DEVELOPMENT

	No. of Copies
Rockwell International/North American Aircraft Operations............ Attn: Technical Library P.O. Box 582808 Tulsa, OK 74158	1
Rockwell International/North American Aircraft Operations............ Attn: Mr. G. Sherrick, Engineering Research and Technology P.O. Box 582808 Tulsa, OK 74158	1
Rockwell International/North American Aircraft Operations............ Attn: Mr. F. Kaufman P.O. Box 582808 Tulsa, OK 74158	1
Sikorsky Aircraft.. Attn: Technical Library North Main Street Stratford, CT 06601-1381	1
Sikorsky Aircraft.. Attn: Mr. Samuel P. Garbo, M/S S314A2 North Main Street Stratford, CT 06601-1381	1
Sikorsky Aircraft.. Attn: Mr. T. Cook North Main Street Stratford, CT 06601-1381	1
Kaman Aerospace.. Attn: Mr. A. Falcone Old Windsor Road Bloomfield, CT 06002	1
NAVAIRDEVCEN... Tom Hess, Code 60C1	1
NAVAIRDEVCEN... Code 6064	10
NAVAIRDEVCEN... Code 8131	2
NAVAIRDEVCEN... Code 6043	25